REPORT ZD-28-010

DETAIL SPECIFICATION

FOR
MODEL PBY-5A AIRPLANE

AMPHIBIAN FLYING BOAT

PATROL-BOMBER
TWO-ENGINE

21 MAY 1940

BY

CHECKED

APPROVED

DETAIL SPECIFICATION FOR THE DESIGN AND CONSTRUCTION OF MODEL PBY-5A AIRPLANE CLASS VPB PATROL-BOMBER AMPHIBIAN FLYING BOAT (TWO-ENGINE - MONOPLANE)

* *

INTRODUCTION

**1a. This specification covers the requirements for the design and construction of a two-engine Class VPB amphibian flying boat. This airplane shall be known as Model PBY-5A and shall be the same as Model PBY-5 airplane except for changes necessitated by amphibian gear installation.

**1b. This airplane shall be able to take off from either land or water under its own power, alight on either land or water, be hoisted, or be handled on wheels ashore, using its alighting gear.

**1c. The airplane shall be designed for wheel type landing gear.

1d. The airplane shall not be designed for catapulting.

1e. All trial board recommendations resulting from trials of Model PBY-4 airplanes which are applicable to these airplanes and which are authorized by the Bureau of Aeronautics therefor shall be considered a part of this specification.

2a. General Specification for the Design of Airplanes for the U.S.Navy, No.SD-24-D dated 1 September 1935 and changes to date of formal invitation to bid, 20 September, 1939, form a part of this specification and shall be followed except as modified herein. The numbers of the paragraphs of this specification correspond to the numbers of the paragraphs of the General Specification.

2b. All Bureau of Aeronautics service and contract changes authorized for Models PBY-1, PBY-2, PBY-3 and PBY-4 airplanes to date of formal invitation to bid, 20 September, 1939, shall be considered a part of this specification insofar as they apply to airplanes constructed under this specification.

2c. Material, process and design specifications in effect on date of formal invitation to bid, 20 September, 1939, only shall be considered a part of this specification.

17a. No deviation from this specification shall be permitted unless specifically approved by the Bureau of Aeronautics.

PART I

CHARACTERISTICS

101a. The following characteristics are considered reasonable for this airplane and shall be equalled, or, if possible bettered.

**102a. The gross weights are estimated to be as follows:

Bomber (500 gals.fuel)(2-1000# class bombs)	27,092
Bomber (500 gals.fuel)(4-500# class bombs)	27,092
Bomber (500 gals.fuel)(12-100# class bombs)	26,614
Bomber (1000 gals.fuel)(2-1000# class bombs)	30,280
Patrol (785 gals.fuel)(no bombs)	26,774
Patrol (1570 gals.fuel)(no bombs)	31,859
Bomber (500 gals.fuel)(4-1000# bombs)	29,094
Torpedo (500 gals.fuel)(2-Mark XIII torpedoes)	29,130

104a. The useful load as a bomber, including two 1000-pound class bombs shall be subdivided as follows:

USEFUL LOAD		882
CREW (7) with parachutes and life jackets		1400
GASOLINE (500 gals.)		3000
OIL (35 gals.)		263
ARMAMENT		3111
Flexible guns (complete)(2-.30 cal. and 2-.50 cal.)	755.8	
Bombs and Installation (2-1000# bombs)	2139.9	
Pyrotechnics	215.4	
EQUIPMENT		1052
Navigating	56.8	
Miscellaneous	630.4	
Communicating (Radio)	364.3	

NOTE: See Appendix II for detail distribution.

104b. The useful load as a bomber with four 500# class bombs and 500 gallons gasoline shall be 8826 pounds.

104c. The useful load as a bomber with 12-100# class bombs and 500 gallons gasoline shall be 8348 pounds.

104d. The useful load as a bomber with two 1000# class bombs and 1000 gallons of gasoline shall be 12014 pounds.

104e. The useful load as a patrol airplane with 785 gallons gasoline shall be subdivided as follows:

BY_____

CHECKED_____

APPROVED_____

USEFUL LOAD		8508
CREW (7)		1400
GASOLINE (785 gals.)		4710
OIL (50 gallons)		375
ARMAMENT		971
Flexible gun (2-.30 cal.& 2-.50 cal.complete)	755.8	
Provision for bombs	0	
Pyrotechnics	215.4	
EQUIPMENT		1052

104f. The useful load as a patrol airplane with 1570 gallons of fuel shall be 13593 pounds.

104g. The useful load as a bomber with 4-1000# class bombs, 500 gallons fuel shall be 10826 pounds.

104h. The useful load as a torpedo plane with 2 Mark XIII torpedoes and 500 gallons of fuel shall be 10864 pounds.

BY_____

CHECKED_____

** 105a. The weight empty is subdivided as follows:

WEIGHT EMPTY			18,266
Wing Group			4297
Wings (including integral fuel tanks-1750 gals.)		3933	
Ailerons		134	
Struts		230	
Tail Group			499
Stabilizer (including upper fin)		294	
Elevator		113	
Rudder		92	
Fin (built into hull & stabilizer)			
Body Group			6452
Hull (including integral lower fin)		4002	
Auxiliary floats (including retracting mechanism)		472	
Alighting Gear		1978	
Main Gear	1470		
Nose Gear	288		
Retracting mechanism, including hydraulic equipment	220		
Engine Nacelle Group (including oil tanks)			442
Power Plant			4362
Engines (as installed)		2960	
Accessories		270	
Power Plant controls (including pumps, solenoid and relays)		127	
Propellers (including governors & anti-icing provision)		802	
Starting System		108	
Lubricating System (tanks in nacelle structures)		27	
Piping, etc.	27		
Fuel System		69	
Tanks (included in wings)			
Piping, etc.	69		
Fixed Equipment			2213
Instruments		133	
Surface Controls		425	
Furnishings		856	
Electrical Equipment		678	
Anchor, towing, handling gear & hoisting gear		121	

106a. The unit weights of the weight empty items are estimate as follows:

Weight of wing group per square foot net wing area (1400 sq.ft.)
Weight of tail group per square foot tail surface, net (287 sq.ft.)

107a. The crankshaft horsepower for two Pratt & Whitney Model

BY

CHECKED

APPROVED

R-1830-82 engines shall be 2100 HP at 2550 RPM from sea level to 7500 feet; geared 16:9. For take-off the two engines are rated at 2400 HP at 2700 RPM with constant speed controllable pitch propellers. The above ratings are based on 100 octane fuel.

108a. Areas in accordance with Appendix XXI shall be as follows:

Total wing area including ailerons and 0 sq.ft.hull area	1400
Control surface areas	
Ailerons, aft of hinge, 2 at 50 sq.ft.	100
Stabilizer area to elevator hinge including 3.5 sq. ft. hull (fin) area and 18.40 sq.ft. of contained elevator balance	138.2
Elevator aft of hinge including 3.9 sq.ft.tabs	66.6
Fin area including 12.3 sq.ft. contained rudder balance	59.9
Rudder aft of hinge including 1.9 sq.ft. tab	50.9
Total horizontal area (airfoil section	204.8
Total vertical area (airfoil section	110.8

** 111a. The unit loadings shall be as follows:

	Wing Load Lbs./sq.ft.(1400)	Power Loa lbs./HP (2
Bomber (2-1000# class bombs)(500 gals.fuel)	19.3	12.8
Bomber (2-1000# class bombs)(1000 gals.fuel)	21.5	14.3
Patrol (785 gals.)	19.0	12.7
Patrol (1570 gals.)	22.6	15.1

112a. The airfoil section (wings) shall be the NACA 21.

** 113a. The performance is estimated to be as follows:

	Bomber (500 gals.)	Bomber (1000 gals.)	Patrol (785 gals.)	Patr (157 ga
	2-1000# BOMBS		No	BOM
Gross Weight-lbs.	27,092	30,280	26,774	31,
High Speed @ 7,500 ft.	188	184	195	1
High Speed @ Sea Level (MPH)	176	172	183	1
Stalling Speed (MPH) with pwr.	68.5	72.5	68	
Climb to 5000' (min.)	4.7	6.1	43	
Climb to 15,000 ft.(min.)	23.8	28.8	22.4	
Service Ceiling (feet)	19,800	17,100	21,000	16,
Endurance full speed (hrs.)	2.4	4.8	3.7	
Endurance at 175 MPH)at	3.5	7.0	6.2	
Endurance at 145 MPH)7500	5.7	11.0	9.9	
Endurance at 115 MPH)feet	8.0	15.1	13.9	
Take-off in calm (seconds)from water	33	48	32	
Maximum range - statute miles	1,020	1,920	1,610	2,

NOTE: The above performance is based on a crankshaft HP of 2100 at 2550 RPM from sea level to 7500 feet using engines geared 16:9 with constant speed controllable pitch 3-blade propellers. For take-off the engines are rated at 2400 HP at 2700 RPM. The above performance is calculated with all external radio and armament equipment in place for each condition of loading. External removable de-icing shoes shall not be in place in accordance with paragraph 979a.

BY_____

CHECKED_____

APPROVED_____

113c. The airplane at a gross weight of 29,000 pounds shall be capable of sustained level flight with one engine cut out, near sea level until exhaustion of the fuel load.

**116a. The general dimensions shall be as follows:

Span - monoplane	104' 0"
Height over wing on wheels	14' 7-3/4"
Height over tail on wheels	19' 8-1/2"
Height over propellers on wheels	17' 1"
Height from keel to sling in high position	17' 3-1/2"
Length overall	65' 1-3/4"
Angle of thrust line to deck of hull	3 degrees
Forward angle of keel at step to deck of hull	1° 3'
Angle of full load water line to deck of hull	0° 50'
After angle of keel at step to deck of hull	6-1/4°
Leading edge wing at root to C.G. (Weight Empty)	44.2"
Leading edge wing at root to C.G. (785 gal.Patrol)	49.4"
Leading edge wing at root to leading edge M.A.C.	-4.4"
Center of gravity for 785 gal.patrol flying condition, (functional crew) % M.A.C.	27.2
L.E.Wing to Elevator Hinges	41' 8-17"
L.E.Wing to top of Rudder Hinges (inclined)	42' 3.55"
Angle at which wing tip touches water	10-1/2°
Dihedral-due to taper only on outer panel	2° 20' appr
Sweepback	0
Chord	15' 0"
Chord at tip	10' 0"
Mean Aerodynamic Chord	165.32"
Span of Aileron	20' 0"
Chord of Aileron (aft of hinge)(tapered average)	2' 6"
Incidence of Wing	+6°
Clearance of Wing at root above normal water line	7' 9-1/4"
Span of Tail	30' 6"
Incidence of Stabilizer	+4°
Adjustment of Stabilizer	0°
Gross displacement of hull	Approx. 142,295#
Length of Hull	63' 10-7/16"
Beam of Hull	10' 2-1/2"
Height of Hull to Deck Line	8' 4"
Distance from bow to first step of hull	25' 5"
Distance from bow to second step of hull	40' 10-1/2"
Submerged displacement of each auxiliary float	1,572 lbs.
Distance from lowest point of auxiliary floats above the water line (hull horizontal)	8-1/4"
Distance from bow of hull to leading edge wing center section	18' 10-1/2"
Diameter of propeller (3-blade, controllable pitch	12' 0"
Tread of wing tip floats (down position)	90' 8"
Maximum draft (1570 gal.Patrol)	38"
Maximum draft with alighting gear extended	61-1/4"
Tread of Main Wheels	16' 9"

BY

CHECKED

APPROVED

117a. Angular movement for full movement of control each side of neutral (as limited by stops):

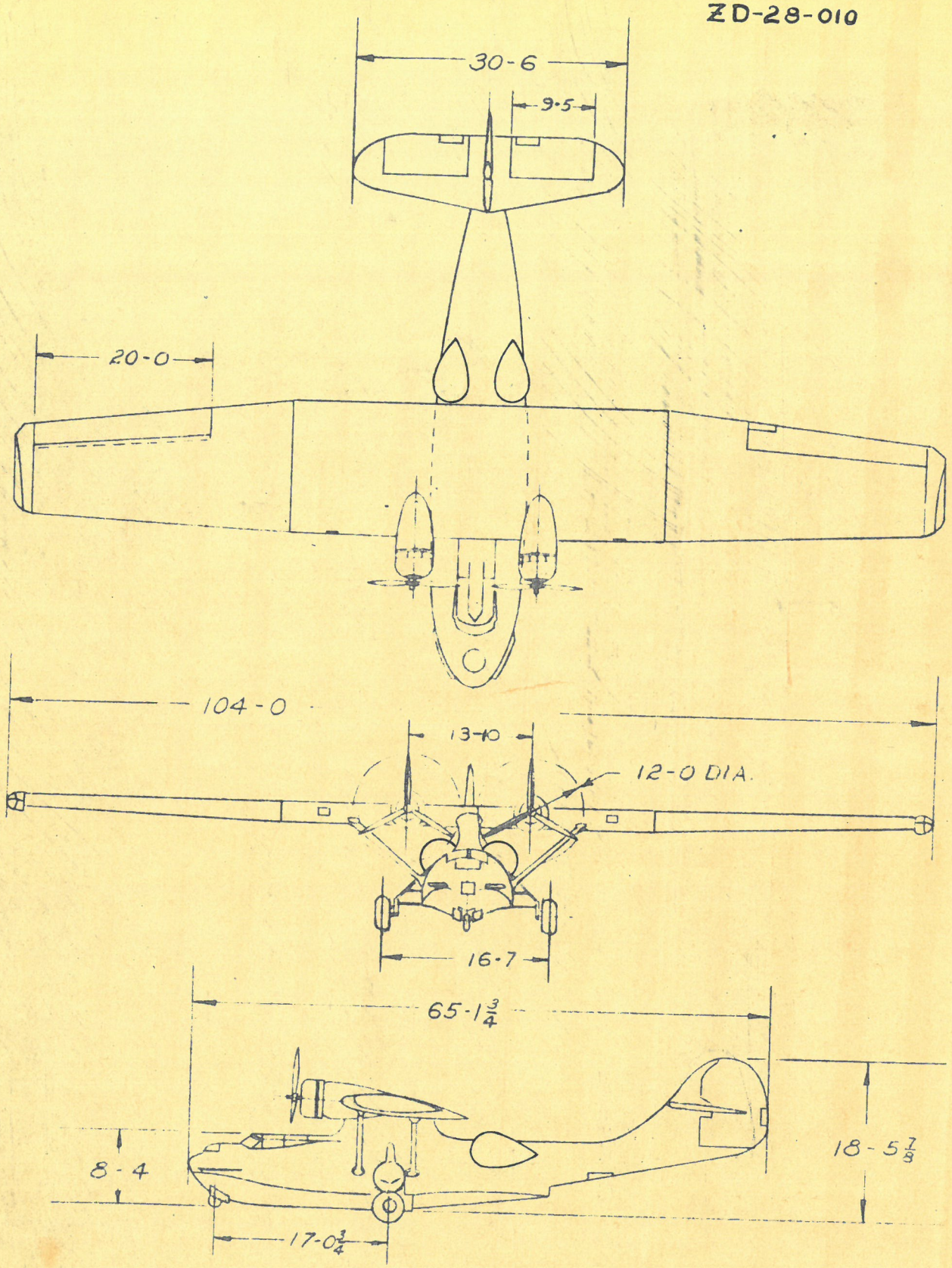
Rudder	29°
Rudder Pedal	6 inches aft, 6 inches forward
Elevator	30° above 20° below
Elevator Control	7-5/16 in.fwd., 10-11/16 in.aft
Aileron	21° above 19-3/4° below
Aileron Control (wheel)	267° right 267° left
Elevator tab	5° above 10° below
Elevator tab control	7.5 turns for 15° of tab movement
Rudder tab control	7 turns for 14° of tab movement
Rudder tab	7° right, 7° left
Aileron tab	15° above, 15° below
aileron tab control	7.5 turns for 30° tab movement

BY_____

CHECKED_____

APPROVED_____

ZD-28-010



AMPHIBIAN - MODEL **PBY-5A**

CONSOLIDATED
AIRCRAFT CORP.
SAN DIEGO, CALIFORNIA

PART II - THE AIRPLANE

SECTION A - GENERAL

**201a. This airplane shall be a two-engine amphibian flying boat which may be used as a patrol, bomber, or torpedo airplane.

**201b. The arrangement of the hull interior shall provide for the following: A revolving windshield in the bow for a gunner, mounting a flexible gun and with provision below for a bomber, a double enclosed cockpit for a pilot and assistant pilot operating side by side, the pilot being on the left side, a radio and navigator compartment, an engineer's compartment, a living compartment with four bunks, two waist gun enclosures mounting two flexible guns, and a tunnel gun position in the bottom of the hull abaft the second step for mounting one flexible gun.

202a. Ready interchangeability between units assembled on any airplane and corresponding spare parts shall be maintained without necessity for selective drilling for attachment to the airplane except as authorized changes may prohibit such interchangeability.

203a. Particular attention shall be given to simplicity and speed with which assemblies such as engines, oil tanks, surfaces, fuel lines oil lines, electric leads, control cables, etc., can be removed and replaced. In order that maintenance costs and operating irregularitie may be reduced to a minimum and that adequate inspection of structures controls, wiring, piping, accessories, etc., may be made, it is essential that the greatest possible degree of accessibility be afforded.

203b. Accessibility satisfactory to the Bureau shall be afforded i the installation of power plants, controls, wiring, piping, and all accessories or equipment which may conceivably require inspection, adjustment, repair or replacement in order that these operations may be accomplished with the minimum expenditure of time and labor. The use of special tools in the fulfillment of these requirements shall be avoided if possible and practicable, but where necessary shall be subject to approval by the Bureau.

203c. The airplane shall be designed to make it possible to remove and install the items here tabulated in the times and with the amount of labor specified. These items represent the sume of the time necessary for gaining access to the unit, time required for removal, time required for replacement and time required for closing openings for replacement. All items similar in nature to those specifically mentioned, but not themselves included in the list, shall be subject to similar time requirements. The actual time required for removal and replacement of each of the parts listed shall be determined by actual test. Though the individual items will not be treated as fixed guarantees, every effort will be made to meet them in each case.

Item	No. of men	Man Hrs.	Hour Min.
Engine (including mount, propeller, etc.)	4	4	0
Magneto	1	0	20
Carburetor	2	2	0
Automatic mixture unit	1	0	30
Starter	1	0	30
Engine Sump Plug (ring cowl in place)	1	0	2
Fuel Pump	1	0	30
Spark Plugs (ring cowl off)	1	0	30
Oil radiator	2	1	0
Ring Cowl	2	0	20
Instrument (standard)	1	0	15
Any fuel valve or strainer	1	0	30
Fire extinguisher cylinder	1	0	20

203d. The Contractor is urged to pay more attention to ease and rapidity of removal and replacement of engines and power plant accessories.

206a. The airplane shall show satisfactory stability and balance as a bomber (2-1000# bombs) and as a patrol plane (785 gallons) throughout the full speed range of the airplane and the full power range of the engines with the crew located as follows:

One man at co-pilot position
One man at pilot's position
One man at navigator's position
One man at radio position
One man at mechanic's position
Two men in bunks

206b. The airplane shall show satisfactory controllability as a bomber and as a patrol plane both in normal and overload condition throughout the full range of speed and engine power with the crew located in battle position. Satisfactory stability and balance shall be provided under these conditions for speeds from cruising speeds to high speed with full engine power and at all speeds without power. The battle positions of the crew are as follows:

One man at engineer position
One man at bow position
One man at pilot's position
One man at radio position
Two men at waist gun positions
One man at tunnel gun position

206c. Balance calculations shall be submitted for all loading conditions including the crew located as given in paragraph 206a and 206b.

206d. Free Control Behavior - The airplane must be sufficiently

BY

CHECKED

APPROVED

stable to permit of operation in smooth or moderately rough air with the controls left free, without acquiring any persistent oscillations attaining any dangerously abnormal attitude or speed, or remaining in any position other than that of equilibrium for more than a few secon without returning to equilibrium.

206e. Static Longitudinal Stability - The static longitudinal sta- bility, both with free and fixed controls, must be definitely positiv for all loading conditions and for all flight speeds, but the stabili should have a minimum positive value for the worst condition.

(a) A curve of stick force required for steady flight, plotted against the speed of flight, shall be smooth in form, without discontinuities or sudden changes of curvature. Its slope shall be everywhere negative from stalling speed up to at least 120% of maximum level flight speed and the maximum values of stick force at the extreme limits of the curve shall not exceed the capabilities of an average pilot.

(b) The curve of equilibrium elevator angle against speed shall also be smooth. Its slope shall be everywhere positive between the same limits as in the preceeding paragraph.

206f. Dynamic Longitudinal Stability - Longitudinal oscillations shall be positively, but not necessarily heavily damped. A long period is more important than quick damping. From level flight at any speed between stalling speed plus 20 miles per hour and the maximum speed, the airplane being properly trimmed, when the nose has been pushed down approximately 10° and held there until the speed has increased by approximately 20 miles per hour and the control wheel then released, the subsequent motion shall be of the nature of a smooth oscillation with a substantially steady decrement. The subsequent motion shall be the same when the bow is pulled up and held until the speed has been decreased by approximately 20 MPH, and then the control wheel released.

206g. Static Directional Stability - Directional stability shall be definitely positive under all power and loading conditions and all spee but subject to being certain thereof, a small degree of positive directional stability is desired. Curves of rudder angle and of force required on the rudder pedals to hold a straight course, plotted agains the amount of eccentric thrust produced by varying the speed of the engine on the one side, shall be smooth, without any reversals of slope The same shall be true of the curve of angle of yaw maintained against eccentric thrust. In particular, none of these curves shall have any flat spot at or near the neutral position.

206h. Dynamic Directional Stability - Directional oscillations shall be positively damped, but again it is more important that the period be long than that the damping be very heavy.

206i. Lateral Stability - Lateral stability in side slip shall be large and positive.

BY_____

CHECKED_____

APPROVED_____

206j. Spiral Stability - At no speed shall the airplane display spiral instability.

206k. Range of Elevator Control - The range of elevator control shall be such as to permit normal landings without bouncing tendencies due to aerodynamic effects at any rate of descent up to 1000 ft. per minute. When close to the water, just prior to completing a landing, it shall be possible, with flaps, if used, either up or down, to bring the airplane to the attitude of minimum speed in level flight and still have some remaining elevator travel available for additional control.

206l. Power of Tabs - The tabs shall be capable of trimming the airplane completely under any condition except of flight at low speed following failure of one engine.

(a) The longitudinal trim device shall be capable of holding the airplane in proper trim with free elevator control at any speed from 70 to 100 miles per hour with the flaps down, if used, and from 80 to 190 miles per hour with flaps up in any power and loading condition.

(b) The aileron tabs shall have enough power to balance the airplane against a dissymmetry of loading corresponding to full [illegible] on one side and empty tanks on the other, plus wing heaviness caused by manufacturing or alignment variations.

(c) The directional trimming device shall be capable of producing complete directional trim at any speed down to at least [illegible] with the engine on one side inoperative.

206m. The airplane shall have good stability and control about all three axis at low speed in the landing condition, and stalling shall be followed by nosing over without tendency to dive or to fall off on one wing.

211a. Particular attention shall be given to the location of the pilots' seats to give the best possible vision in all directions. The bow revolving windshield shall be arranged and constructed as not to obstruct the pilots' vision.

212a. As a patrol plane with 785 gallons of fuel, the clearance for 12' 0" diameter propeller over the normal water line shall not be less than 4' 0".

217a. Suitable provision shall be made to permit boarding the airplane when afloat or ashore from either side. Access shall be provided at the rear top hatch.

217b. A walkway shall be provided on the deck of the hull from the trailing edge of the center section to the root of the fin and also from the bow revolving windshield to the center superstructure. Suitable

steps and grips of low-drag design shall be provided on tail surfaces to facilitate inspection and access to all control surfaces, all control surface hinges and fittings requiring lubrication.

217c. A suitable walkway not less than 6" wide shall be provided along the front beam from each nacelle to the wing tip floats. The entire center section from the front beam to the rear beam shall be suitable for walkway purposes and in addition from the leading edge to front beam between nacelles, shall also be suitable for walkway purpos A strip not less than 12 inches wide shall be provided on the center l of the center section from the rear beam to the trailing edge. Suita hand rail shall be provided on the side of the center section walkway. Special tread covering of approved type shall be provided in all loca- tions where access is difficult or hazardous to personnel, ashore or afloat, as may be required by the Bureau.

217d. Walkway areas shall be provided for access to and operation bomb hoists.

217e. A suitable mooring rail, steps and grips of low drag design shall be provided on both sides of the bow cockpit to permit mooring and anchoring operations, and for entrance to the pilots' cockpit. T top metal frame at center of windshield shall be rugged enough for use as a step. Steps shall be provided in the bow cockpit to permit access to the side rails for mooring operations.

217f. Suitable platforms, attachable at each side of each engine nacelle, shall be provided to facilitate servicing the engines when afloat. Suitable stowage shall be provided for working platforms.

217g. Access to the center section over the leading edge and over the trailing edge shall also be provided.

219a. Fittings for mooring and towing operations shall be supplied on the hull.

219b. Provision for anchor gear shall be made in the bow of the hu

220a. The hull shall be provided with necessary fittings for attachment of beaching gear.

221a. All inspection doors in the hull and tail surfaces shall be adequately water-proofed and protected from air leaks.

227a. The use of split-end taper pins and cottered taper pins is prohibited in aircraft construction. The remaining provisions of this paragraph in SD-24-D Change No.3 shall apply.

229a. All cotter pins shall be corrosion resistant steel.

236a. Particular attention shall be given to the exclusion of sea water and rain from the interior of all parts of the ~~airplane structure~~.

CHECKED

APPROVED

236b. Particular attention shall be given to the security of removable cowling, fairings, inspection doors, etc., to prevent loosening or tearing off in flight.

240a. A finish schedule in general accordance with Appendix XII shall be submitted to the Bureau for release.

241a. The Contractor shall apply necessary service and squadron insignia and markings in accordance with detail information to be furnished by the Bureau.

241b. Owing to the position of the propellers, painting of the tips and rear faces of the propeller blades may be omitted.

244a. All control cables shall be stretched prior to installation by the application of a load equivalent to 60% or the rated strength of the cable terminal assembly.

247a. All demonstrations and trials of the airplane shall be conducted with fixed radio antenna in place, with retractable radio direction finder loop, if used, retracted otherwise in place, with all armament equipment housed in stowed position or in low-drag position for each specified condition of loading.

260a. There shall be no blind or inaccessible structure. Members of all units or assemblies such as wings, stabilizers, fin, rudder, elevator, etc., shall be provided with inspection doors, removable sections or lighting holes that will permit internal and external inspection of all structural parts, removal of corrosion products, and refinishing, However, access to inaccessible structure shall be as provided in the prototype airplane.

261a. Fittings which may become damaged in service shall be attached by means of replaceable bolts.

263a. Particular attention shall be given to the detail design and construction to prevent excessive concentrations of carbon-monoxide in any crew space. Tests for carbon-monoxide shall be conducted by the Contractor in accordance with Bureau of Aeronautics Specification SR-93.

SECTION B - THE AIRPLANE STRUCTURE

GENERAL

315a. The airplane structure, including hull, auxiliary floats, wings and tail surfaces, shall be of riveted construction except that bolts and nuts may be used for attaching structural fittings and structural parts to each other and to the airplane structure. Bolts may also be used in parts of the airplane structure that are not accessible for riveting operations.

316a. Approved type anti-friction bearings shall be provided for control surface hinges. Anti-friction bearings shall also be provide for all control cable pulleys and for the principal bearings of the c trol surface system.

316b. Approved type anti-friction bearings are not considered to require provision for lubrication.

322a. Castings shall not be used for rudder pedals.

328a. All external skin on wings, body and empennage shall be of sufficient gage or shall be sufficiently stiffened so that no objectionable breathing or wrinkling will appear in flight in rough air.

328b. The skin of the wing in the slipstream shall be of sufficie gage or sufficiently stiffened to prevent fatigue due to slipstream ac

328c. The hull skin opposite the inboard propeller disks shall be easily replaceable and shall be of such stiffness as to protect the structure from serious damage due to ice thrown from the propellers.

328d. Where metal parts necessarily rub, as in certain portions of the cowling doors, etc., easily replaceable chafing strips of synth tic rubber, suitable treated webbing or canvas shall be provided. Whe ever practicable, the rubbing strips shall be fastened to the fixed me bers rather than the removable ones. In the case of fillets or other semi-permanent parts, either the possibility of chafing shall be defin ly eliminated, or some adequate means of protection against chafing of the metal shall be provided.

328e. Wherever louvres are installed in the skin or cowling, they shall be adequately stiffened to prevent cracking in service.

STRENGTH

329a. The structure shall not be designed for arresting or catapulting.

329b. Strength calculations shall be submitted and summarized on V-g diagrams, showing the strength of the airplane under air loads for

Factors of Safety: The factor of safety for air conditions on true arbitrary yield, whichever is the lower, shall be 1.15 at all speeds at all angles of attack at which the design accelerations are not determined by the bump. The factor of safety between ultimate and yie shall be not less than 1.35.

Gust Strength Investigations: Calculations shall be submitted and s marized on V-g diagrams to show the maximum speeds at which the struc designed in accordance with the requirements described herein, will w stand the 30 f.p.s. level flight gust for the most critical load dist butions at various gross weights between the design gross weight and 31,000 lbs. In calculating the accelerations due to the 30 f.p.s. gu an effective gust factor shall be obtained from Figure 1 for each gro weight considered.

** 329e. I. Take-off & Alighting as a Flying Boat: With the loading of paragraph 104f less sufficient fuel to make the gross weight equal 26,000 pounds the structure shall be designed for a vertical componen of the alighting acceleration of not less than 6.0 g., with a factor of safety on ultimate of not less than 1.35. For the bow landing con dition the design rotational acceleration shall be 10 radians per sec ond per second with a total vertical acceleration of 3.5 g.

II. Take-Off & Alighting as a Landplane: With the loading of paragraph 104f less sufficient fuel to make the gross weight equal 26,000 pounds, the structure shall be designed for a vertical componen of the alighting acceleration of not less than 4.0 g. The analysis co ditions shall be the same as for the XPBY-5A. No dynamic applied load tests shall be required.

329f. Control Surfaces: The design applied loads on the horizontal and vertical tail surfaces shall be as approved by the Bureau. The factor of safety based on the approved applied load shall be not less than 1.35. The ultimate design load for the horizontal tail surfaces shall be not less than 50 pounds per square foot, for the vertical su faces not less than 35 pounds per square foot, for the ailerons not le than 40 pounds per square foot, and for the flaps not less than 60 pounds per square foot.

329g. The following Bureau of Aeronautics Specifications and Structures Bulletins shall be followed in the strength calculations where applicable to the design:

SB-44 - Applied Load Centroids
SB-33 - Calculations of Terminal Velocity for Structural Design Purposes.
SS-2A - Specification for the Determination of Applied Loads on Wing Cellules of Airplanes.
SA-273- Determination of Wing Coefficients by Extrapolation
SS-3 - Structural Design of Wing Group
SB-45 - Aileron Roll.
SB-14 - Unsymmetrical Gust
SS-6B - Determination of the Chord Distribution of Pressure on

Airfoils (Flapped or Unflapped)
SS-8A - Determination of the Amount and Chord Distribution of Air Load on Wings of an Airplane for any Span Increme (Including upper and lower surface pressures and consideration of internal pressure).
SB-39 - Fuselage Analysis
SF-1B - Hulls and Floats
SS-4 - Specification for the Delineation of the Stress Analysi Strength V-g Diagram. (Neutral wings, flapped wings an roll conditions).

Also, the following Structures Bulletins:

3, 5, 6, 9, 10, 11, 13, 14, 15, 16, 17, 19, 20, 21, 22, 23, 24, 29, 30, 31, 33, 34, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60.

NOTE I: Attention is called to the fact that SB-39 (fuselage analysis) applies also to hulls; that SB-20 describes the method of obtaining design tail loads; that SB-53 describes the method of obtaining the span distribution; that SB-45 (aileron roll) is modified by the requirements given above under unsymmetrical conditions; that SB-54 gives information in regard to the distribution of tail loads; that SB-51 and SB-49 are equally applicable to hulls, and that SB-48A applies to pitching acceleration and tail loads, and SB-57 applies to the design of the hull for forward bottom loads. Although the bulletins listed in this note should be given special consideration the other bulletins listed in the preceding paragraphs are also of importance.

332a. The values of allowable stress intensities shall be as agr upon between the Contractor and the Bureau. Recommended values must supported by acceptable test results.

334a. The principal strength fittings in aluminum alloy structur shall be aluminum alloy forgings forged to final shape wherever prac cable. Fittings machined from aluminum alloy bar stock may be used subject to Bureau approval. Combinations of metals involving steel m be used subject to Bureau approval. However, parts approved for the prototype, shall not be resubmitted for approval.

WING GROUP

364a. The wing group shall be arranged as a braced high wing monoplane.

365a. The wing group shall consist of one wing of three panels, one center and two outer. The center panel shall be attached to the hull at the center line by means of a streamlined monocoque structure and braced to the hull by means of struts. The outer panel shall be removable but shall not fold.

365b. The wings shall be of aluminum alloy beam bulkhead and stressed skin construction, except that the portion abaft the rear beam shall be of aluminum alloy rib, fabric covered construction.

365c. Provision shall be made for carrying eight Mark XXXV and four Mark XLII bomb racks symmetrically on the center wing panel outboard of the engine nacelles. The wings shall be designed to carry one 1,935 pounds torpedo on each side in a structure inboard of the bomb racks carrying the 1000 pound bombs. Four Mk. XXXV bomb racks are carried within the wing.

365d. Each auxiliary float shall be hinged and retract to the wing tip. The outboard contour of the float shall fair above the upper surface of the wing when the float is retracted.

365e. Provision shall be made for the installation of approved type landing lights in the leading edge of the center panel on each side of the centerline of the airplane.

365f. The fuel spaces shall be of 10% "Alclad" aluminum alloy. This requirement applies to sheet and sections made from sheet or strip stock, however, this requirement does not apply to extrusions and sections not commercially available in "Alclad" aluminum alloy.

366a. The wings shall be designed and constructed for maximum watertightness. Unavoidable openings shall be arranged to prevent accumulation of salt water and the surrounding structure finished to prevent active corrosion of the wing structure.

369a. Access to the aileron hinges from the upper wing surface shall be provided.

369b. Approved type tread covering shall be applied on all walkways as required by the Bureau. (See paragraph 217a, b and c).

370a. The rib spacing in outer wing panels shall be 13-1/2 inches. The rib spacing of the center wing panels shall be 15 inches outside the slipstream and 10 inches in the slipstream. The rib spacing forward of the ailerons shall be 19 inches.

371a. The trailing edge shall be stiffened, and the wing aft of the rear spar shall be covered with approved type fireproofed fabric within a space extending from at least 5 feet outboard of one nacelle to 5 feet outboard of the other nacelle.

371b. Rings of aluminum alloy at least 2 inches in diameter shall be provided about half-way out on the span and accessible from the top side of the wing for attachment of wing lines. These rings shall be recessed into the leading edge and removable for replacement.

373a. The ailerons shall be of aluminum alloy torque box and rib construction, fabric covered.

373b. Ailerons shall be designed to prevent the formation of ice on the leading edges or elsewhere to the extent which would impair their effectiveness.

373c. A trimming tab operable by the pilot in flight shall be provided on one aileron.

373d. The ailerons shall be operable by the pilot against full setting of the trimming tab without hazard to the pilot or to the airplane.

374a. Ailerons shall be statically and dynamically balanced in accordance with the requirements of U.S.Army Air Corps Handbook, Part V, paragraphs 83(c), and 83 (d), revised July 1, 1939, except that the axi of oscillation shall be located 249" from the centerline of the airplan and that the dynamic balance coefficient shall not exceed 0.065.

379a. All wing struts shall be non-adjustable as to length.

379b. Boat hook grabs shall be provided at the rear of each after diagonal strut about 3-1/2 feet outboard from the hull. Sharp edges on the inside of the fittings shall be removed to prevent chafing of lines which may be passed to them.

379c. Fairings at lower ends of forward lift struts shall be so designed that beaching gear can be installed without removing fairing.

385a. Complete approved type anti-icing equipment shall be installe on the leading edge of the wings. Necessary accessories shall be furni ed and installed by the Contractor.

386a. Each outer wing panel shall be provided with at least two fittings which will permit lifting the wing panel of the airplane into place during assembly or disassembly.

387a. Anchorages shall be provided at each nacelle and the adjacent center section for attaching an approved type engine hoist.

BY_____

CHECKED_____

APPROVED_____

TAIL GROUP

390a. Tail group shall consist of a stabilizer, elevators with controllable tabs, a fin, and a rudder with controllable tab. Surfaces shall be easily removable for disassembly and stowage.

390b. The stabilizer and fin shall be of aluminum alloy construction and smooth sheet covered except that the stabilizer overhang shal be fabric covered. The elevator and rudder shall be of aluminum alloy construction and fabric covered.

394a. The stabilizer shall be non-adjustable. Longitudinal trim shall be obtained by use of tabs at the trailing edge of the elevators The tabs shall be controllable by the pilot in flight.

395a. Suitable walkway areas shall be provided on the top surface of the stabilizer for access to the hinges on the elevators.

395b. Steps shall be provided on leading edge of fin for access to the top of the stabilizer.

399a. That part of the fin below the stabilizer shall be an integr part of the hull. That part of the fin above the stabilizer shall be integral part of the stabilizer.

403a. Movable tail surfaces shall be statically and dynamically balanced in accordance with U.S.Army Air Corps Handbook, Part V, parag 83(c) and 83(d) revised July 1, 1939, except that the dynamic balance coefficient shall not exceed 0.067.

404a. The tab on the rudder shall be controllable by the pilot in flight.

405a. No external brace struts or wires shall be used in the tail group.

407a. Particular attention shall be given to the attachment of fab to the tail surface frames.

408a. The tail surfaces shall be designed and constructed for maxi watertightness for all conditions of flight or landing. Unavoidable op ings shall be arranged to prevent accumulation of salt water and the su rounding structure shall be finished to prevent active corrosion of the structure.

409a. All movable control surfaces shall be designed to prevent the formation of ice on their leading edges or elsewhere to the extent whic might impair their effectiveness.

410a. The tail surfaces shall be operable by the pilot in flight, during and immediately after take-off, against full setting of trimming

tabs without hazard to the pilot or to the airplane.

410b. Complete approved type anti-icing equipment shall be provided and installed by the Contractor on the stabilizer and fin. Necessary accessories and connections for operation with the anti-icing units on the wings shall be provided.

tolerance of plus or minus 0.005", in order that the closest possible fit between the engine and the mount may be obtained without forcing or transmission of excessive stresses.

426b. The attachment of the engines to the engine mount shall incorporate vibration absorbing devices of approved design. See paragraph 503e for flexible pedestal mounts. Attaching bolts shall be straight.

426c. Adequate tests shall be conducted in connection with the design of the engine mounting to insure that the natural vibration frequency of the mount-engine combination does not correspond with the torsional vibration frequency of the engines at any engine speed which may be used, either for idling or warming up on the ground, or in normal or gliding flight. The method of testing the engine vibration mounting shall be developed with the advice and approval of the engine and the propeller manufacturers.

428a. The engine cowling shall be reinforced to eliminate cracking at sharp bends. Cowl supports shall be incorporated in the cowling and shall be removable with it insofar as possible.

428b. The top engine cowl abaft the ventilator shall be reinforced for use as a step when filling the oil tanks.

428c. The door in the top of the engine cowling shall be adequate in size for filling of oil tank.

430a. A ring cowl (NACA type) with controllable skirt flaps shall be provided for each engine. The skirt flap controls shall be located in the engineer's compartment, adjacent to the thermocouple temperature gage. Provision shall be made for closing the skirt flaps independently of each other in an emergency. The cowl shall be of aluminum alloy and anchored only to engine. Each ring cowl, or sufficient sections of each ring cowl to provide easy access to the engine, shall be readily removable without removal of the propeller. The cowl may be hinged or in suitable sections.

432a. A suitable bombing window shall be provided in the bow of the hull. The window shall be of plate laminated glass. The installation of the window shall be watertight.

432b. A watertight metal cover for the bomber's window shall be provided on the inside of the hull which shall be removable and replaceable with bombsight in place. Satisfactory fasteners shall be provided for the window. Means of positioning the window when installing shall be provided. Provision shall be made for stowage of this cover when not in use.

432c. Provision shall be made for cleaning both sides of the bomber

window while in flight. A non-watertight metal cover shall be provided on the outside of the hull to protect the window from accidental breakage. This cover shall be operable in flight. The crank which operates this cover shall be provided with a handle. The hull shall be made watertight where outside control cover mechanism pierces hull.

433a. There shall be one window in the radio compartment and one for the navigator's compartment. They shall be of laminated glass of sufficient size to illuminate the equipment by daylight. The window in the navigator's compartment shall be so located as not to be blanked off by the radio set. Other windows shall be provided for enclosed crew spaces requiring illumination in flight.

433b. Two fixed windows of non-inflammable transparent synthetic resin of approved type shall be provided, one on each side of the centerline of the hull in the deck abaft the pilots' cockpit. One window of the above type shall also be provided on starboard side of the hull to illuminate the tunnel gun position.

434a. A hinged metal cover shall be provided for the navigator's position. The cover shall operate satisfactorily in flight without danger of loss overboard.

434b. Hatches with sliding covers shall be provided over the pilots' seats and at the engineer's station. The covers shall be operable in flight.

434c. The window opening at the engineer's station shall be suitable for egress of the engineer in case of emergency on the water. The engineer's window shall be of non-inflammable transparent synthetic resin of approved type.

436a. Adequate metal flooring shall be provided to insure freedom of movement of the crew on long flights. The flooring shall be readily removable for inspection of the hull bottom. Sufficient flooring shall be provided in the navigator's, engineer's and sleeping compartments. All flooring shall have adequate strength and shall be properly fitted and secured to eliminate rattling in flight.

436b. Flooring in all gunner's compartments shall be easily removable, particularly in places where loose ammunition may drop.

437a. Engines shall be mounted on each side of the centerline of the airplane on nacelle structures built out from the wing. These structures shall be of aluminum alloy construction. Each engine mount proper, however, shall be a welded steel tube structure.

437b. The engine nacelles may be designed to permit removal of the engine mount and engine as a unit.

438a. Nacelle and engine cowling shall be attached by means of quickly

operable flush type fasteners and each piece shall be removable without disturbing adjacent pieces.

**440a. The wheel type alighting gear shall be of the tricycl retractable type.

**442a. The alighting gear shall be so designed that with the airplane in the three-point position, the attitude of the wings will be one which gives less than 50% of the maximum lift.

**443a. The angle in the side elevation between the vertical a the line connecting the center of gravity (normal patrol loading and the center of the main axles shall not be less than 8 degree with the airplane under stafic load in the three-point position.

**447a. A self-draining well shall be provided in each side of hull into which the main wheels may be retracted. The wells sha enclose approximately two-thirds of each wheel. Doors shall be vided to cover the strut openings when the gear is retracted.

**447b. A self-draining well shall be provided in the under si of the hull to hold the nose wheel in its retracted position. Th well shall be watertight with respect to the inside of the hull shall be provided with doors for closing the well when the wheel retracted.

**448a. The main wheels shall be 47-inch, smooth contour, equip ped with brakes and anti-friction bearings.

**449a. Tires and tubes shall be of the smooth contour type.

**450a. The main wheels shall be provided with power operated hydraulic brakes.

**451a. Brake controls consisting of auxiliary pedals mounted o the rudder pedals shall be provided for both pilots. Individual control of each brake shall be provided. A valve shall be provid for locking the brakes by hydraulic pressure from an accumulator the airplane is not in operation.

**453a. A 30-inch smooth contour tail wheel, [illegible] and tube shall be used on the nose gear. No brake shall be provided.

**457a. A phenolic rubbing block shall be installed at the base the second step as a contact point for the hull in the tail low po tion.

**458a. Extension and retraction of the wheels shall be accompli by hydraulic jacks. An equalizer shall be installed between the ja for the main wheels. Spring operated locks with hydraulic release shall be provided for holding the gear in both the extended and re tracted positions. A hydraulic jack shall be provided for operati of the nose wheel doors. The hydraulic operating valve shall be located at the pilot's station. Means for manual operation of the gear after failure of the power supply shall be provided.

CHECKED

**458b. A combination of warning and indicating lights shall be

APPROVED

provided to inform the pilots when the wheels are up and the engines are throttled below 1200 RPM, when the wheels are up and locked, when the wheels are down and locked, and when the nose wheel door is locked.

468a. The auxiliary floats shall retract to form the tips of the wing. Both floats shall be retracted at the same time by a screw mechanism to be electrically and mechanically operated. Complete retraction or extension of both auxiliary floats shall not require more than 20 seconds in a temperature of 32 degrees F. and at airplan speeds not exceeding 120 MPH. The controls for the retracting mechan shall be located convenient to the engineer. The electrical retracti mechanism shall be readily operable when the airplane is in flight, taxiing, or at rest. Rugged automatic locks shall be provided to hol the floats in the fully retracted position.

468b. A suitable warning device for the electrical retracting mechanism shall be provided which will warn the pilot and the engineer the wing tip floats are retracted and the engine RPM is below that required to maintain level flight with normal full load.

468c. The lines of the wing tip floats shall be in accordance wit Appendix XXIV. The floats shall be of approved type construction.

468d. Wing tip floats shall not be interchangeable right and left.

468e. Moving parts of the retractable float operating mechanism exposed to salt water corrosion such as chain, sprockets, gears and special assembly bolts shall be of corrosion resistant materials or construction, or treated with substances that tend to check corrosion in service.

468f. All pin joints in the auxiliary float structure and retracting mechanism shall be provided with means of compensating for looseness resulting from wear.

468g. All retracting mechanism for operating the auxiliary floats that requires frequent inspection, lubrication, or adjustment or replacement shall be readily accessible for servicing.

468h. The wing tip floats shall be designed and tested in the same manner as on the prototype airplanes.

469a. Two watertight bulkheads shall be provided in each wing tip float, dividing the float into three compartments.

470a. Each watertight compartment in the auxiliary float shall hav ample means for access for draining, inspection and refinishing the e tire interior of each auxiliary float.

470b. Provision shall be made for draining the interior of each watertight compartment by means of a power operated bilge pump and flexible hose. The Contractor shall furnish necessary hose for draining ashore or afloat. (See paragraph 904a.)

BY

CHECKED

APPROVED

473a. The lines of the hull shall be in accordance with Appendix XXV subject to final release by the Bureau of Aeronautics.

473b. The hull shall be of aluminum alloy construction of approved type.

473c. Exposed riveting on the outside and bottom of the hull shall present a smooth appearance, using low drag type of riveting.

473d. The hull shall extend aft beneath the rudder to protect it from green water in the heaviest overload condition.

474a. The hull shall be provided with a rubbing strip of special extruded section of aluminum alloy. The strip shall be secured to the keel with aluminum alloy rivets.

476a. A section of the rubbing strip at the main step, not less than 24" in length, shall be of aluminum alloy and readily replaceable, using aluminum alloy horizontal rivets.

477a. A water-proof canvas covered laminated cork bumper shall be installed at the bow of the hull.

478a. Suitable ventilators shall be provided for each crew position and in the living compartment. The ventilators shall be arranged to prevent induction of exhaust gases, gasoline fumes and air heated by the engine. The ventilators shall be watertight in the closed position only.

480a. Water rudder shall not be provided.

484a. A demountable snubbing post, or equivalent fittings shall be provided on or near the bow of the hull adjacent to the revolving windshield. The fittings shall be thoroughly secured to the main hull structure. The fitting shall be amply strong to sustain heavy impact loads resulting from temporarily securing and mooring the airplane in open water and from snubbing at a buoy in the open water.

484b. A recessed cleat shall be provided on the port and starboard mooring platform.

488a. Steel chain and cable of non-magnetic characteristics shall be used in the control system in the pilots' cockpit except that carbon steel cable may be used in the control system of the automatic flight control.

489a. An opening shall be provided on the underside of the hull, to the rear of the second step to accommodate the rear tunnel gun. A suitable door shall be provided. The door shall be readily opened and closed in flight and shall be watertight when closed.

BY_____

CHECKED_____

APPROVED_____

490a. Particular attention shall be given to the attachment and securing of non-structural parts and items of equipment to prevent rattling in flight.

491a. Aluminum alloy containers filled with potassium chromate crystals shall be provided in the bottom of spaces where bilge water may accumulate.

492a. Provision shall be made for removing and replacing auxiliary power unit in the hull.

SECTION C - POWER PLANT

ENGINES

500a. The arrangement of the power plant shall be subject to approval by the Bureau.

503a. The two engines to be furnished by the Government shall be Pratt & Whitney Model R-1830-82.

503b. The Pratt & Whitney Model R-1830-82 engines are each rated at 1050 HP at 2550 RPM from sea level to 7500 feet altitude, geared 16:9. For take-off each engine is rated 1200 HP at 2700 RPM. These ratings are based on 100 octane fuel.

503c. The Contractor shall provide the shielding for the low tension system.

503d. Eacn engine will be equipped with constant speed governor unit and limit stop. The engines will be equipped with injection type automatic mixture carburetors.

503e. Flexible pedestal mounts in accordance with Pratt & Whitney drawing #36345 will be furnished with each engine for mounting the engine, but the weight of these units shall be included as part of the engine mount. Detail information regarding these mounts may be obtaine from the engine manufacturer or from the Bureau.

505a. Suitable disconnect plugs, fuel and oil connectors, etc., shall be provided at or near the firewall to facilitate removal and replacement of each engine.

ENGINE ACCESSORIES

518a. The engine ring cowls and such other parts as necessary shall permit the engine sump plug to be readily removed. Sufficient clearance shall be provided around the plug to allow the oil to drain from the sump without dripping on the ring cowl or any other part of the airplane.

521a. An oil cooler of approved type shall be furnished and installed by the Contractor for each engine. Provision for cooling the oil shall be adequate for maintaining inlet oil temperatures not in excess of 80 degrees C. at best climbing speed between sea level and highest rated altitude, and with strut air temperature of 90 degrees F. at sea level. Oil coolers shall be readily accessible for servicing and replacement when the airplane is at anchor or ashore.

521b. An automatic oil temperature control and check valve of approved type shall be furnished and installed by the Contractor for each engine. The check valves shall prevent seepage of oil into the engines when the engines are not in operation.

521c. Provision shall be made for the installation of a propane st or equivalent for heating the engine during cold weather, and for dryi the engine during damp weather. Provision shall be made for circulati of heated air and the products of combustion throughout the engine spa and around the oil tank.

523a. No special provision shall be made for preheating the intake air; however, provision shall be made for alternate protected source o intake air. The source of air to the carburetor shall be controllable the engineer.

525a. A Government furnished carburetor air thermometer shall be i stalled by the Contractor for each engine convenient to the engineer, but only in the first airplane for test purposes. The weight of this item shall not be included in the weight empty.

529a. A complete exhaust collector in accordance with Appendix XXX shall be provided for each engine.

529b. The exhaust collector ring shall be so designed that any engi cylinder can be removed without removing any of the main portion of the collector ring. It shall also be possible to remove any section of the collector ring without disturbing any other section. The use of baffle in any part of the exhaust system shall be avoided.

529c. All parts of the exhaust disposal system shall be so located, and ventilated as to prevent any adjacent structure from reaching a tem perature which might in any way impair its strength, or constitute a fire hazard.

535a. An engine driven vacuum pump shall be furnished by the Contra and installed in each engine nacelle for the air driven instruments and the anti-icing equipment. An oil separator of approved type shall also furnished and installed for each pump by the Contractor so as to return the oil to the engine sumps. The exhaust from each separator shall be piped to the anti-icing system.

** 535b. An engine driven hydraulic pump shall be furnished by the Contractor and installed on the right hand engine. A fluid reservoir, a relief valve, and pressure regulator shall also be furnished and installed near the pump.

539a. Breather pipes shall be provided and installed by the Contractor to conduct oil vapors from the engine crank case breather to the open air. The discharge shall be on the under side of each nacelle, flush with the cowl, and clear of bombs, torpedoes and exhaust outlets.

ENGINE CONTROLS

540a. The engine controls shall be of Contractor's design and suitable for twin-engine operation.

542a. The engine controls shall be so installed that the engines can be controlled individually or simultaneously with one hand from either pilot position. No spark control shall be provided.

542b. The mixture control shall be manual and automatic. The mixture controls shall be located at the engineer's station. The last 10 degrees of the mixture control segment shall be marked in red to indicate the position of the mixture control for stopping the engine through the idle cut-off units. Erection instructions shall indicate this equipment.

545a. All exposed controls on the engine installations shall be protected from the formation of ice.

PROPELLER

551a. Constant speed controllable pitch full feathering propellers with governor units and feathering control accessories shall be provided by the Government and installed by the Contractor. The following accessories shall be included with each propeller: feathering pump, push button switch and solenoid relay.

554a. Rugged propeller governor controls shall be furnished by the Contractor and installed readily accessible to the pilot. The Contractor shall also furnish and install the necessary wiring and conduit for connecting and operating the feathering devices.

558a. Provision shall be made by the Contractor for connecting and operating anti-icing equipment on the propellers. The propellers will be equipped with anti-icing devices but the contractor shall furnish all necessary piping, pumps, reservoirs, controls, etc., for anti-icing operation.

STARTING SYSTEM

561a. The starting system shall consist of a Series 40 combined hand-electric inertia starter with automatic booster coil and engaging solenoids, for each engine.

564a. The hand engaging starter controls shall be located on the engine nacelles in positions accessible to operating personnel for hand operation. Remote contact switch for electric engagement in accordance with Bureau of Aeronautics Drawing R-5H shall be provided at the engineer's position. The controls for hand operation shall be of the positive push-pull type.

565a. Provision shall be made for starting the engines by hand at the nacelles.

567a. A suitable priming system shall be provided for each engine. Engine primers shall be of approved type.

BY_____

CHECKED_____

APPROVED_____

COOLING SYSTEM

581a. The cowling shall be arranged to insure cooling of engine cylinders, crankcases and accessories on the ground, in taxiing, and in flight. Provision shall be made to permit circulation of air arou the oil tank and the engine accessories. The engine cowling shall be of approved design.

581b. Cold air shall be supplied to the oil cooler from the outsi

587a. Deflectors or cylinder baffles shall be as furnished with t engines by the Government.

589a. Provision shall be made for supplying cold air to the magne

592a. Twenty-eight point thermocouple equipment cylinder tempera- ture gage and selector switches shall be provided by the Government a installed by the Contractor for the first airplane for measuring temp ture of cylinders at the rear spark plugs and flanges of one engine. Temperature gages and switches shall be installed within reach and si of the engineer. The 28-point equipment shall be installed so that i may be removed without mutilation of the airplane. The weight of the 28-point thermocouple equipment shall not be considered a part of the normal weight empty. The other engine shall be equipped with a perma- nent single-point thermocouple installation. The single-point equip- ment for both engines shall be included in the normal weight empty. After trials of the first airplane, the 28-point equipment will be re- placed by the Contractor, by a permanent single-point installation.

592b. All other airplanes after the first airplane shall have sing point thermocouple installations for each engine as permanent installa tions. Weight of single-point installations shall be included under Weight Empty.

LUBRICATING SYSTEM

651a. The lubricating system shall consist of an oil tank, oil quantity gage, sounding rod, piping, fittings, drain valve and suit- able means for controlling the cooling of oil for each engine. Oil coolers and automatic oil temperature control valves are also used, but are included under "Engine Accessories".

651b. The oil system shall be so arranged that either engine may be removed without draining the oil tank.

654a. Each oil tank shall have an oil capacity of not less than 55 gallons plus not less than 8 gallons expansion space. Oil tanks shall be identical and interchangeable. The design of the oil tank shall be such that not more than 10 gallons of oil will be circulated by each o temperature control valve in warming up the engines.

BY_____

CHECKED_____

APPROVED_____

657a. A suitable oil quantity gage shall be provided by the Contractor for each oil tank. In addition, a sounding rod shall be provided for each tank. The rod shall be graduated to indicate the level of the oil when the airplane is at rest on the water for servicing. oil quantity gage shall be graduated for normal flight and shall be visible to the engineer.

658a. The oil tank vent shall be located at the highest point of the oil tank.

659a. Each oil tank shall be of riveted aluminum alloy sheet and constructed as a structural member connecting the engine mount to the wing beam.

662a. The oil tank shall not be vibrated. However, the oil tanks shall be subjected to standard pressure tests.

665a. Filler units of approved design shall be furnished by the Contractor.

665b. The filler units shall be accessible and arranged to facilita servicing operations. Filler units shall be an integral part of the tanks and shall be located at the highest part of the tank.

669a/ Oil suction, return, and vent lines shall be of approved flexible connections, metal tubing, or solid aluminum alloy tubing 52S (Navy Department Specification 44T32) with flexible connections. The vent lines shall be 3/4 inch O.D. x .049" tubing or equivalent. The return lines shall be 1" O.D. x 0.049" tubing or equivalent, and the suction line shall be 1-1/2" x .049" tubing or equivalent.

679a. Flexible hose connections shall be in accordance with Appendix XXVII. At no place shall flexible connections be used on only one end of a tube.

682a. No provision shall be made for immersion oil heaters in the oil tanks.

683a. Oil cooling shall be accomplished by means of an oil cooler for each engine. Oil temperature control valves shall be provided as noted in paragraph 521b.

687a. An oil drain valve shall provide for completely draining each oil tank. The oil shall drain clear of the airplane. A rigid support shall be provided for the oil drain valve.

687b. Oil drain valves shall be so located that when the airplane is at rest a hose may be connected for draining the oil into a container on the ground or in a boat. A drain scupper shall be provided below the engine oil strainer.

BY_____

CHECKED_____

APPROVED_____

689a. A thermometer to indicate the temperature of the outlet oil for each engine shall be installed on the first airplane only. The weight of this installation shall not be included in the normal weigh empty.

694a. A large capacity removable oil screen of No.10 mesh shall be provided in each oil tank for screening only the service oil. The screens may be of brass mesh.

697a. Each service oil tank shall be provided with a small sump o equivalent for catching dirt and sediment, and shall be drainable whe the airplane is at rest.

FUEL SYSTEM

700a. The fuel system shall consist of necessary fuel tanks in th wing, piping, AEL-1 fuel system units, quantity gages, fittings, valv and controls. The fuel system shall conform in general to the requir ments of Appendix XXII, and shall be a series system. The suction lift of the engine driven pump shall not exceed 36 inches. The fuel system shall be set-up and tested in accordance with Appendix XXII unless the system has already been tested and a report submitted to th Bureau.

700b. The fuel system shall be arranged to permit the maximum flex bility of fuel supply consistent with simplicity and low weight. The arrangement shall permit filling of main tanks simultaneously from two supply hoses connected to high capacity pumps.

700c. The fuel system shall be submitted to the Bureau for approva

700d. A supply of not less than 15 gallons of fuel shall be provid ed in a separate reservoir for the auxiliary power unit. The reservoi may be provided inside one of the main fuel tanks in the wing by suit- able baffling, or equivalent but shall be piped directly to the unit w no other outlet for the fuel. Suitable shut-off valve shall be provid near the tank to control flow of fuel. Approved type flexible connec- tions shall be provided as required. A suitable check or pressure rel valve shall be provided in the line from the fuel supply to the auxili power plant to relieve the hydrostatic pressure on the carburetor. Th supply shall not be included in the normal fuel load, but as an item u "Useful Load, Equipment, Miscellaneous". Fuel for normal operation of auxiliary power unit shall be taken from the separate reservoir.

703a. The fuel system shall be so arranged that in an emergency, one or both main engines can feed from any tank from either hand fuel pump, or from either engine driven fuel pump.

706a. The fuel system shall be so arranged that the entire fuel sup ply can be used when the airplane is flying at an angle of 15 degrees glide or climb.

BY_____

CHECKED_____

APPROVED_____

709a. The hand fuel pumps or pump operating levers shall be locat in the engineer's position. The hand pump operating levers shall be arranged to permit operation singly or together with one hand.

709b. Two type AEL-1 fuel system units shall be furnished and installed by the Contractor.

711a. The fuel tanks shall be an integral part of the wing. Suitable manholes shall be provided for access to any part of the interior of the tanks.

712a. The total capacity of the entire fuel system shall be not le than 1750 gallons, including supply for auxiliary power units.

712b. No provision need be made for reserve fuel.

714a. The fuel tank spaces shall be riveted "Alclad" (10%) aluminu alloy construction. Dissimilar metals shall be avoided in the constru tion of fuel tanks.

714b. Fuel tank baffles shall be so constructed and installed that failure due to work hardening of the material will not take place.

718a. Fuel tanks shall not be subjected to vibration tests. Howev tanks shall be subjected to pressure tests in accordance with Appendix XV.

721a. Each fuel tank shall be provided with one filler unit of approved type. The units will be furnished by the Contractor. The filler units shall be an integral part of the tanks. The filler units shal be not less than 4" in diameter.

723a. Coarse mesh screens (No.10 mesh) similar to AN-4007 shall be provided inside the fuel tanks over the fuel outlets except for s tand-pipe outlets. Screens shall be removable for cleaning at infrequent intervals.

726a. Vents shall be arranged to prevent entrance of water while ta ing or at rest, and to facilitate rapid refueling.

726b. The vents shall not cause any syphoning action and the outlets shall be so located that they will not become plugged with ice.

727a. A sump shall be provided for each fuel tank. Drains shall be provided for draining water or sediment out of these sumps. The fuel outlets shall be arranged to leave about 1 quart in the lower portion o the sumps for collection of water and sediment.

729a. Suitable means shall be provided through which the entire fuel supply may be drained out in a reasonable time when airplane is afloat on its beaching gear ashore.

BY

CHECKED

APPROVED

729b. The interior surfaces of the fuel tanks including such fittings as may be installed therein shall preferably be free from flange or pockets which might collect or retain water or sediment. Limber holes shall be provided in or located where pockets are structurally unavoidable.

731a. Direct reading suspended float type fuel gages shall be furnished and installed by the Contractor for each fuel tank. The gages shall be readily visible to the engineer. An inclinometer and calibration charts shall be provided to facilitate correct readings of fuel in the tanks. Ample clearance shall be provided for the floats in the fuel sight gages. Shut-off valves shall be provided to prevent leakage in case of a broken sight tube.

731b. The installation of the fuel gages shall be in accordance with Appendix XXIII. Calibration of fuel tanks and plates shall be in accordance with Appendix XXIII. Fuel tanks shall also be calibrated for the attitude of the airplane on the beaching gear ashore.

733a. Fuel piping shall consist of 52S0 aluminum alloy solid wall tubing (Navy Dept. Spec. 44T32) with approved type flexible connections.

734a. Main fuel lines feeding only one engine shall be not less than 3/4" x .049" tubing. Feed lines between tanks and selector valves shall be not less than 1" or 0.049" tubing. Primer lines shall be not less than 1/4" x .034" tubing.

734b. Fuel vent lines shall be not less than 3/4" x 0.049" tubing.

738a. Flexible hose connections shall be in accordance with Appendix XXVII. At no place shall a flexible connection be used on only one end of a tube.

740a. All main fuel system strainers shall be drainable for cleaning in flight.

742a. Approved type fuel flow meters with integral by-pass shall be provided and installed by the Contractor for each engine. The installation shall be convenient to the engineer. Each flow meter shall have a capacity of not less than 100 gallons per hour.

743a. The fuel control valves shall be installed so that the indicator shows the correct position of each valve to the engineer.

744a. Provision shall be made for dumping all of the fuel that can be carried, clear of exhaust outlets and openings in the hull. The controls for the dump valves shall be arranged to prevent accidental operation.

745a. At places where there is a possibility of fuel or oil lines

SECTION D - FIXED EQUIPMENT

INSTRUMENTS

802a. The instrument and navigation equipment installation shall be in accordance with Appendix XXIII.

** 802b. The following instruments shall be installed in the pilots' cockpit:

Two artificial horizon indicators
One automatic flight control unit
Two airspeed indicators
Two altimeters
One clock (elapsed time)
Two compasses
Two turn and bank indicators
Two indicators, electric tachometer
Pilot director indicators for Mark XV bombsight (one mounting in front of each pilot)
Two directional gyros (one for each pilot)
Two manifold pressure gages
Two rate of climb indicators
One air thermometer
One tachometer synchronizer unit
One suction gage
Two hydraulic pressure gages

802c. The instrument arrangement for the pilot and assistant pilot shall be identical except as noted.

802d. The following instruments shall be installed in the bomber's cockpit:

One airspeed indicator
One altimeter
One lateral Inclinometer
One air thermometer

802e. The following instruments shall be installed in the radio-navigator compartment:

One airspeed indicator
One clock (elapsed time)
One altimeter

BY _____

CHECKED _____

APPROVED _____

802f. The following instruments shall be so installed as to be readily visible to the engineer:

Two thermocouple temperature indicators
One lateral inclinometer
Two fuel pressure gages
Two oil pressure gages
Two oil temperature gages
Two oil thermometers (outlet) first airplane only
Two fuel quantity gages
One oil quantity gage (dual type)
Two fuel flow meters
Two carburetor air temperature indicators (1st airplane onl
Two indicators, electric tachometer
Two manifold pressure gages
One altimeter
One clock
One air thermometer

802g. All altimeters and the climb indicators shall be vented through 3/16" tubing to an electrically heated pitot static tube furnished by the Government and installed by the contractor.

802h. Shock absorbing mounts shall be provided for all instrument boards except the engineer's panel.

802i. All instruments for the auxiliary power unit shall be furnished with the auxiliary unit.

805a. All instruments shall be adequately illuminated. The instrument boards shall be normal to the deck line.

808a. All instrument piping shall be aluminum alloy (52S0) tubing appropriate size, as indicated by the connections on the instruments. Airspeed indicator, altimeter and climb indicator piping may be of 3/ tubing. All connections shall be rigid or flexible as required. Uni shall be provided at the junction of the outer wing panels and places subject to disassembly. Aluminum alloy fittings shall be of approved design.

810a. Magnetic material in the vicinity of each compass shall be eliminated as far as practicable. Particular attention shall be given in the detail design to the elimination of small isolated parts of magnetic material within a radius of 24" from the compass. This requirement also applies to movable parts such as cockpit enclosures, switches, propeller and other controls furnished by the Contractor.

810b. A removable compass mounting box with support brackets shall be provided for use of the navigator.

BY_____

CHECKED_____

APPROVED_____

811a. Voltmeters, ammeters, certain types of pilot director indicators, electric tachometer or similar instruments, and all single conductor grounded return wiring carrying direct current shall be located not nearer than 12" from the center of the compass. Voltage regulators and automatic circuit breakers shall be at least 18 inches from the center of the compass. All direct current wires within a radius of 18" from the center of the compass shall be carried in twisted pairs.

812a. The maximum deviation of the compass with compensating magnets removed, the airplane in normal flight attitude, all fixed equipment installed, and under any specified loading conditions shall not exceed 12 degrees. The changes in compass reading due to normal operation of any electrical circuit in the airplane shall not exceed 2 degrees. In case the above limits are exceeded, instructions shall be requested from the Bureau of Aeronautics.

813a. The venturi shall be omitted due to use of engine driven vacuum pumps.

814a. One air thermometer (electric type) shall be installed convenient to the bomber, one convenient to the navigator, and one for the engineer. Each thermometer shall indicate outside air temperatures and so located that the readings will not be influenced by exhaust gases.

815a. A liner with a #60 drill size orifice and an air chamber approximately 1" O.D. x 3" long shall be incorporated in the fuel pressure gage line to eliminate fluctuations of the fuel pressure gage. A similar restriction shall be provided in the oil pressure gage lines at the engine end.

816a. The two turn and bank indicators and the 2 directional gyro indicators and two artificial horizon indicators shall be driven by two vacuum pumps, to be furnished and installed by the contractor (See paragraph 535a). The two vacuum pumps shall be interconnected with a suitable selector valve operable by the pilots. A suction regulating valve shall be installed in accordance with Appendix XXIII.

817a. The Contractor shall install one electrically heated pitot static tube to be furnished by the Government.

862a. Shock absorbing limiting stops shall be provided on the rudder, ailerons and elevators. These stops shall attach directly to the control surface masts or equivalent, and shall limit the movement of the surfaces so as to prevent damage to hinges or surfaces when the latter are displaced by gusts of wind or propeller blast.

862b. Positive stops shall be installed at the control column to come into play only when the bumpers on the elevators are compressed.

866a. The stabilizer shall be fixed.

866b. Longitudinal trim shall be accomplished by means of adjustable tabs on the elevators. The tabs shall be controllable by the pilots in flight.

871a. An indicator shall be provided to show the position of each tab or sets of tabs with respect to the surface. The indicators shal be visible to both pilots.

872a. A locking bar shall be provided which, when fastened in place to the yoke and pilot's control wheel, will hold the elevators and ailerons in neutral.

872b. A pin type lock shall be provided for locking the rudder. The lock shall be controllable by the pilot.

873a. All flight controls shall be so arranged and installed that when adjusted properly at a temperature of 60 degrees F. they shall neither become so tight that they will not trail properly, or that th forces required in carrying out maneuvers will be substantially increased, nor so slack as to be objectionable to the pilot, or to involve any flutter danger, when the temperature is subsequently decrea to 0 degrees F. or increased to 125 degrees F. Similar temperature variations shall have no objectionable effect on engine or other controls.

874a. All engine, propeller, and flight controls shall be installed in such a manner as to eliminate any possibility of induced movement or binding of any control surface (the cockpit controls being fixed) by structural deflections of wings, body, or engines which result from the application of load equal to 60 percent of the design loads in any condition.

FURNISHINGS

881a. All seats shall be designed to afford maximum comfort on long patrols and shall not provide any accommodation for parachutes.

882a. The pilots' seats shall be adjustable forward and up in flight. Satisfactory positioning mechanism for the pilots' seats shall be provided. The inboard edge of the seats shall be modified to facilitate access to and from the seats. The pilots' seats shall be adjustable for tilting in flight. Shields shall be provided in the seat mounts to prevent catching the hand between the seat and the mount. The seat backs, arm rests and cushions shall be deeply upholstered and such upholstery shall be easily removable.

884a. A swivel chair with padded back shall be provided for the navigator. This chair shall be mounted on a swinging arm which can be locked.

884b. A swivel chair with back rest shall be provided for the radio operator. Stops shall be provided on this seat at 30 degrees and 100 degrees from the fore and aft centerline of the seat. A suitable desk with lock-drawers shall be provided for convenience of the radio operator. Pigeon holes shall be provided as space permits. A suitable locker for classified matter, and a spare parts box shall also be provided. This unit shall be approximately 18" deep, 12" wide, and provide a section for classified matter 5" high and a spare parts section below it 10" high. The door shall be labeled and shall be provided with a lock of the internal type. All doors in lockers and drawers shall be provided with simple catches to keep them closed in flight without actually locking. However, locks shall be provided as required.

884c. Suitable seating with back rest shall be provided for the engineer.

884d. Omitted.

884e. A suitable seat and removable back rest shall be provided f the bomber. The seat shall be adjustable vertically about 6".

884f. All seats shall slide or fold out of the way where necessar to facilitate ready passage through the hull.

** 888a. Two fixed and two folding bunks shall be provided in the living compartment. Provision shall be made for attaching a safety belt on each bunk.

889a. Upholstered seat and back cushions shall be provided for each pilot's seat. The navigator's seat shall be upholstered, also the radio operator's seat.

890a. Suitable pads shall be provided for the bomber at the bomb

BY_____

CHECKED_____

APPROVED_____

sight, for the gunner at the tunnel gun, and for the crew at the waist gun positions if necessary.

890b. The bomber's kneeling pads shall be suitably secured to prevent displacing them.

891a. Safety belts of approved type shall be furnished by the Government and installed by the Contractor as follows: One pilot type for each of the two pilots, for the navigator, the engineer, and for the radio operator, one gunner type for each of the gunner positions (1 forward and 3 aft); and one commercial type for each bunk.

892a. All instrument boards and instrument panels except engineer's panel shall be mounted on shock absorbing mounts of approved type.

895a. Tools and miscellaneous gear lockers shall be provided in the engineer's compartment. The lockers shall be reinforced to permit use as a step or seat.

895b. Lockers with a total capacity of not less than 6.5 cu.ft. shall be provided for stowage of fresh food.

896a. Space shall be made available for stowing baggage and personal effects of the crew, and for food in packages or containers. An adjustable shelf shall be provided in the food lockers.

896b. Suitable provision shall be made for stowage of parachutes convenient to members of the crew.

897a. Water containers of corrosion resistant steel and similar to Naval Aircraft Factory Drawing No.56778 for the amount of fresh wa specified in paragraph 1016a shall be provided.

900a. General reduction of noise shall be accomplished by careful attention to detail structural security of metal parts, doors, drawer and other parts that may rattle or come loose in flight.

901a. A fabric screen shall be provided between the pilots' and bomber's cockpits. Suitable fabric shades or tinted transparent material shall be provided over the pilots' heads to protect the pilots eyes from excessive sun glare and reflection. Screens or shades shal be provided for deck windows in the navigator's compartment. All screens shall be secured with fasteners that may be readily operated flight.

902a. Fabric covers shall be provided for the engines, the bow en closure and the pilots' enclosure.

902b. Space shall be provided for stowage of all the fabric cover but the weight of these covers is not to be included in the normal weight empty.

BY_____

CHECKED_____

APPROVED_____

903a. An approved type chemical toilet which may also be used as a dry toilet shall be provided and installed by the Contractor.

903b. Provision shall be made for the storage of paper bags for alternate use in the toilet in lieu of chemicals.

903c. One relief tube shall be provided convenient to the crew.

904a. A power driven bilge pump shall be furnished as part of th auxiliary unit (NEP-1). The Contractor shall furnish suitable rubber hose with necessary end connections and a strainer. The length of hose shall be sufficient to reach all watertight compartments. Th hose shall be 1" inside diameter, non-collapsible and rubber lined. Provision shall be made for stowage of the hose.

905a. A map case of approved design shall be provided under the pilot's seat.

905b. Provision shall also be made for charts and maps required by the navigator.

909a. A pressure fire extinguisher system using one cylinder of 7-1/4 pounds of carbon dioxide shall be installed and connected for protection of both nacelles through two-way selector valves. The extinguisher shall be installed for operation by the engineer. The equipment shall conform to the requirements of Appendix XIII except that the tubing shall be 7/16" O.D. x 0.042" wall and the connections shall conform to BuAero Drawing 5945. The release valves shall be of the short-pull type. All parts of the installation shall be furnished by the Contractor. Control handles and distributor lines shall be marked in accordance with Appendix XVIII. The tubing shall be bonded to the structure in accordance with Appendix IX. The cylinders shall be installed in a vertical position. The satisfactory operation of the fire extinguisher system shall be established by actual test.

** 910a. Three portable carbon dioxide fire extinguishers (2# capacity shall be furnished and installed by the contractor, one in the forward part of the hull, one in the after part of the hull, and one amidship

910b. One 5-pound CO_2 portable fire extinguisher shall be furnished and installed by the Contractor in the mid-portion of the hull. The extinguisher shall be in accordance with Appendix XXVI.

913a. Provision shall be made for stowage of the Mark II chart board convenient to the pilot.

913b. The stowage rack for the float lights shall be located in the rear part of the hull.

BY_____

CHECKED_____

APPROVED_____

913c. Provision shall be made for stowage of an approved type spotlight and also for mounting the spotlight on top of the bow gunner's windshield in a horizontal position. The spotlight when mounted shall be accessible for use from the forward cockpit in flight. The spotlight shall be furnished by the Government.

914a. Suitable ladders and portable platforms shall be provided by the Contractor for access about the airplane as may be necessary.

914b. The section of the rear access ladder bearing against the hull shall be suitably reinforced.

915a. Provision shall be made for the stowage of a Mark VII life raft. The life raft shall be readily removable from the hull for use. The life raft shall be furnished by the Government.

** 916a. Deleted.

917a. The Contractor shall provide a suitable table for use of the navigator. The table shall be as large as the space available permits. A drawer of rugged construction shall be provided in the table. A ledge approximately 1/2" high shall be provided around the edges of the chart table. The chart table shall also be suitable for use as a bunk. The top of the table shall be suitable for thumb tacks.

918a. Provision shall be made for stowage of 7 parachutes (detachable type). The parachutes shall be convenient to each member of the crew for whom they are intended for use.

918b. Provision shall be made for stowage of 7 life jackets.

918c. Two hot-plates and one percolator shall be provided for preparation of food.

BY_____

CHECKED_____

APPROVED_____

** 920a. A hydraulic system shall be provided for the operation of the alighting gear retracting mechanism and the wheel brakes. The system shall consist of a pump driven by the right hand engine, a fluid reservoir, a pressure regulator, a relief valve, an accumulator, and the necessary control valves and piping. A hand pump shall be provided for emergency use.

BY_____

CHECKED_____

APPROVED_____

ELECTRICAL EQUIPMENT

922a. The electrical installation shall be in accordance with Appendix X, except as otherwise directed or authorized by the Bureau

922b. The electrical system shall be a 24-volt system except as otherwise specified.

925a. Two 24-volt generators similar to type NEA-2B generators shall be installed and incorporated into the electrical system. The generators, batteries, and associated electrical equipment shall be installed and connected in accordance with Bureau of Aeronautics Drawing R-2K, except that the generator control boxes shall be located in the hull.

925b. One type NEB-1A auxiliary gasoline power unit with integral one gallon tank, bilge pump and generator shall be permanently installed and connected into the electrical system. The unit shall be located approximately 20" above the normal water line. The engine exhaust pipe shall be muffled and shall project through the hull so as to conduct exhaust away from the hull openings when the power unit is being operated. A flap valve shall be installed where the exhaust leaves the hull to prevent the entrance of water. The auxiliary power unit will drive a 24-volt generator, type NEB-1D.

925c. Instructions shall be provided in a conspicuous position near the power unit warning the crew to keep the hull compartment open when running the auxiliary power unit.

925d. Adequate instructions for starting and operating the auxiliary power unit shall be incorporated in the maintenance and operating instructions.

927a. One type S-34 integrally shielded battery shall be installed near each engine in the wing or in each nacelle. Two type S-17 batteries connected in series shall be installed for the radio equipment in the radio compartment if practicable. The batteries shall be readily accessible for inspection and removal as required.

927b. Provision shall be made for paralleling the batteries for radio operation if necessary.

929a. Type F running lights and suitable exterior lights shall be furnished by the Government and installed by the Contractor. Bureau of Aeronautics Drawing R-14I and R-39F shall be followed where applicable in the installation of exterior lights.

929b. A covered switch shall be provided for operating the anchor light from outside the hull when the airplane is moored.

BY_____

CHECKED_____

APPROVED_____

931a. One approved type landing light shall be provided by the Contractor and installed in the leading edge of the center panel on each side of the centerline of the airplane away from interference with propeller circles.

931b. The landing light installation shall be in accordance with Bureau Drawing R-3 (latest revision).

932a. Six flashlights (2-cell size) in accordance with Navy Dept. Spec. #17F7b shall be furnished by the Government and installed by the contractor (one for each gun position and two for general use).

934a. At least one receptacle shall be provided in each compartment for plugging in portable lights. Each compartment shall be satisfactorily illuminated. Additional lights shall be provided as needed at the various crew positions. An additional dome light shall be provided in the engineer compartment. The switches for the dome lights in the navigator's and sleeping compartments shall be located close to the after door of the respective compartments.

934b. All instrument panels, navigator's table, chart boards and controls shall be lighted in accordance with Bureau of Aeronautics Drawing R-36F and R-47B.

935a. An electric signal light arrangement shall be provided to facilitate communication between the pilot and the engineer. The arrangement shall provide for regulating the intensity of the light signals, particularly for night operation.

936a. An outlet shall be provided in the engineer's compartment for connecting to cooking utensils.

938a. The pilots' switch panel shall be mounted on the bulkhead between the pilots' seats. The lighting of the panel shall be controllable.

944a. The ignition switch shall be located on the control yoke in the pilots' cockpit.

946a. A direction finder loop of the plug-in type with remote control device shall be furnished by the Government and installed by the Contractor. The weight of the loop is chargeable to "Useful Load - Radio".

947a. The airplane shall be bonded in accordance with Appendix IX. Particular attention shall be given to the type and location of bonding devices in order to prevent corrosion and weakening of important structural members.

949a. Electrical conductors shall be suitable for 24 volts,

however, the conduit sizes may be the same as those used on the prototype airplane.

950a. A rheostat (NAF 213666-100-0.5) and voltmeter (NAF 38922-5 shall be furnished and installed by the contractor on the bomber's panel and connected so as to control and indicate the voltage input to the bombsight - SBAE system.

ANCHOR, TOWING & HANDLING GEAR

952a. One 31 pound Northill type non-magnetic steel anchor or approved equivalent and 150 feet of 1/4" (6600# rated strength) corrosion resistant steel cable anchor line shall be provided and installed in general accordance with Appendix XIV. The towing pendant shall be 3/8" (13000# rated strength) corrosion resistant steel cabl with suitable means to prevent chafing the hull. The anchor shall be wholly enclosed when in the stowed position in flight. Suitable means shall be provided for readily handling the anchor from the hull. A suitable reel and crank shall be provided for the anchor line. The hatch in the anchor stowage compartment shall not be wate tight. The anchor compartment shall be watertight with respect to the hull interior and shall incorporate a drain to the outside of the hull.

952b. A heavy roll edge shall be provided around the anchor hatch to prevent damage to the anchor line and hull and to permit clamp fitting to be hauled in.

956a. Provision shall be made for towing and mooring in accordance with Appendix XIV. The clamp shall have a demonstrated holding power of not less than 5000 pounds on the 1/4" anchor cable. The clamp shall be so designed that it can be fitted to the cable when there is a load on the anchor gear, and shall be such that it does not put a sharp kink in the cable or cut the cable when in use.

956b. A suitable snubbing post arrangement shall be installed. (See paragraph 484a).

956c. The fittings for attaching towing pendant to the hull shall permit vertical as well as horizontal angularity and shall be of corrosion resistant steel.

HOISTING

959a. A two-point hoisting sling in accordance with Appendix XVI except that its maximum service load shall be 21,000 pounds, shall be provided and shall be carried at all times. The lifting eyes shall be of forged steel. Provision shall be made for stowage in the engineer's compartment when not in use.

BY_____

CHECKED_____

APPROVED_____

HANDLING

962a. Wing handling lines shall be provided. Fittings shall also be provided outboard on the wings for attachment of the handling lines as specified in paragraph 371b. These fittings shall have 2-inch clea opening and be capable of taking 2500# load ahead or at 30 degrees.

962b. In addition, fittings shall be provided on the nose and sterr of each wing tip float for handling on the beach. The fittings shall have a clear opening of not less than 2 inches.

967a. A portable strut and cable support with block and tackle shal be provided for changing propellers while afloat. Fittings shall be provided on the upper surface on the wing for attaching the support. The support is not to be included in normal load.

967b. The arrangement of supports of the propeller hoists shall prevent collapse when side load is applied.

968a. Fittings shall be provided on outer wing panels as indicated in paragraph 386a.

BEACHING GEAR

**977a. No beaching gear shall be provided. The wheel type alighting gear shall be suitable for handling the airplane on a 10 to 1 ramp.

SPECIAL EQUIPMENT

979a. Each airplane shall be completely equipped with approved type ice-elimination equipment. Complete anti-icing equipment shall be provided by the Contractor for the wings, stabilizer, and fins. The propellers shall be modified by the Government for anti-icing operations; however, necessary pumps, tubing, fittings, reservoirs, removable shoes and associated materials to complete the anti-icing equipment shall be furnished and installed by the Contractor. The controls for the equipment shall be convenient to the pilot. The first airplane shall be demonstrated in flight with the entire anti-icing equipment in operation to show that the characteristics of the airplane in flight have not been adversely affected by the operation of the anti-icing equipment, and that the equipment functions satisfactorily. This demonstration shall be made before the Trial Board prior to final acceptance of the first airplane. However, the weight of the external removable shoes on the wings and on the tail surfaces, and the weight of the liquid for the propellers shall not be included in the Weight Empty. All other parts of the equipment shall be included in the Weight Empty. External removable shoes shall not be in place during guarantee demonstrations.

BY_____

CHECKED_____

APPROVED_____

SECTION F - USEFUL LOAD

CREW

983a. The crew shall consist of 7 men and includes one parachute and one life jacket for each man.

FUEL AND OIL

988a. The fuel load shall be as follows:

Bomber (2-1000# class bombs - Normal)	500 gallo
Bomber (2-1000# class bombs - Overload)	1000 "
Bomber (4-500# class bombs)	500 "
Bomber (12-116# class bombs)	500 "
Patrol (Normal)(No Bombs)	785 "
Patrol (Overload)(No bombs)	1570 "
Patrol (Maximum)(No Bombs)	1750 "
Bomber (4-1000# Class Bombs)	500 "
Torpedo (2 torpedoes Mk.XIII)	500 "

992a. The oil load shall be as follows:

Bomber (2-1000# class bombs - Normal)	35 gallons
Bomber (2-1000# class bombs - Overload)	60 "
Bomber (4-500# class bombs or 12-100# class bombs)	35 "
Patrol (Normal)	50 "
Patrol (Overload)	100 "
Patrol (Maximum)	110 "
Bomber (4-1000# Class bombs)	35 "
Torpedo (2 torpedoes)	35 "

ARMAMENT

996a. The armament installation shall consist of the following main items:

1 - .30 cal. flexible gun & 1000 rds.of ammunition in bow cockpit
2 - .50 cal. flexible guns & 800 rds.of ammunition in the waist gun positions in the rear part of the hull
1 - .30 cal. flexible gun & 500 rds.of ammunition in the tunnel gun posi
1 - Bomb sight installation Mark XV-4 in bow of hull.
Bomb racks to carry the following:
2 Demolition bombs (1000#)Class, OR
4 Demolition bombs (500#)Class, OR
4 Demolition bombs (1000#)Class, OR
12 Demolition bombs (100#)Class, OR
2 Torpedoes (1935#)
2 - Very's Pistol and 48 rounds of ammunition
14- Aircraft parachute flares
2 - Smoke grenades
18- Float Lights
2 - Pilot director indicators (non-magnetic type)
1 - Torpedo director, Mark XXVIII

BY_____

CHECKED_____

APPROVED_____

996b. The Contractor shall make trial installation of all armamen equipment in each airplane in order to insure proper installation and operation in service.

996c. Modification of armament accessories is not permitted without specific approval of the Bureau in each case.

999a. Provision shall be made for carrying one .30 cal. flexible gun and 1000 rounds ammunition in bow cockpit, two .50 caliber flexible guns with 300 rounds in the side waist gun positions and one .30 caliber flexible gun and 500 rounds of ammunition at the rear tunnel position.

999b. The mounts for all flexible guns shall be of an approved ty All gun mounts shall be furnished and installed by the Contractor. The weight of all flexible gun mounts is charged to "Furnishings". The flexible guns shall be installed in an approved manner and shall consist of the following:

I. The .30 cal. bow gun installation:

1 - Browning aircraft flexible machine gun .30 cal. M-2 (B.O.204674)	20.0
1 - Ring sight Mark VI (B.O.189730)	1.0
1 - Wind vane sight, D-4 (B.O.150305)	0.6
1 - Gun latch (Furnishings)	
1 - Ejected link container Mark III (B.O.190208)	1.1
1 - Ejected case container Mark III (B.O.190206)	1.6
1 - Gun mount adapter-Mark III (B.O.190200)	3.4
1000 Rds.ammunition with links in magazine assemblies Mark I (B.O.178456)	80.0
Racks for 9 ammunition magazines (Furnishings)	
	107.7

II. The Waist Gun Installation - .50 cal. (Normal Load)

2 - Browning flexible aircraft machine guns .50 cal. with muzzle stabilizers (B.O.190714)	145.8
2 - Wing sights, Mark VII (B.O.199170)	2.4
2 - Post Sights, Mark IV (B.O.199170)	0.6
2 - Gun Latches (Furnishings)	
2 - Ejected case containers (B.O.182419) Mk.II	9.2
2 - Ejected Link Containers	3.6
2 - Gun mount adapters (B.O.204154 and 264812) Mark V (right hand and left hand respectively)	42.0
800 Rds.of .50 cal. ammunition with links including 16 magazine assemblies (B.O.182413)	377.6
Racks for 16 - .50 cal. ammunition magazines (Furnishings)	
	581.2

BY_____

CHECKED_____

APPROVED_____

III. The Tunnel Gun Installation in Rear Part of Hull:

1 - Browning aircraft machine gun flexible .30 cal. M-2 (B.O.204674)	20.0
1 - Ring sight, Mk. VIII (B.O.204036)	0.4
1 - Post sight, Mk. V (B.O.204036)	0.4
1 - Gun latch (Furnishings)	
1 - Ejected link container Mark III (B.O.190208)	1.1
1 - Ejected case container, Mk.III (B.O.190206)	1.6
1 - Gun Mount adapter Mk. III (B.O.190200) or special type	3.4
1 - Gun Mount (Contractor's design)(Furnishings)	
500 Rds. .30 caliber ammunition with links in magazine assemblies, Mk. I	40.0
Rack for 4 Mk. I ammunition magazines (Furnishings)	
	66.9

999c. Racks shall be provided for the required flexible gun magazines at each gun position. The magazines shall be so located that they are convenient to the gunner and shall permit removal from the rack with one hand. The racks for all ammunition for waist guns shall be removable. (Weight of all magazine racks is chargeable to Weight Empty - Furnishings).

999d. The Contractor shall furnish and install gun latches of his own design for all gun emplacements.

999e. The intent of the arrangement of guns indicated above is to provide the maximum gun fire in the after hemisphere

999f. A revolving windshield shall be provided for the bow gun. Each waist gun position shall be suitable for optional installation of the following: A .50 cal. flexible gun with suitable mount affording maximum arcs of fire. The waist gun positions shall be protected by suitable enclosures faired into the sides of the hull. These enclosures shall rotate about a longitudinal axis and shall provide protection for all positions in which the guns may be fired. The rear tunnel gun position shall be suitable for installation of a .30 cal. flexible gun with special mount. The hatch in the hull bottom shall, when opened, offer no interference to the gun or gunner and shall be readily closed, forming a watertight closure assuring the watertightness of that portion of the hull bottom.

1000a. The installation of a Mark XV Mod.4 bombsight in conjunction with the Mark I, Mod.1 automatic flight control equipment in the bow of the hull shall be in accordance with Bureau of Aeronautics Specification SR-31 except as noted herein. All parts of the automatic flight control equipment except the bombsight proper, shall be included under weight empty. The electrical portion of the installation of the Mark XV-4 sight shall be in accordance with BuAer Dwg.R-201. Suitable provision shall be made for accommodating the anti-vibration mount consis

of four Lord type shock-absorbing biscuits. A watertight metal cover shall be provided for the bombsight. The cover shall be strong enough for use as a step. Similar protection shall be provided for exposed units of the automatic flight control equipment.

1000b. Attitude Control Device - The Contractor shall provide and install an attitude control device of a torque drive type similar to that indicated on BuOrd Dwg.267701, together with adequate flexible torque shafting and casing to connect the pilot's control device to the 90° drive on the flight control gyro. The attitude control device system shall be self-locking by use of a fine thread control device.

1000c. The pilot's control device shall be similar to the standard commercial torque drive type cockpit control used for auxiliary control surfaces. The device should have an indicating pointer and scale with pointer to control handle radio of 1 to 36.57. One turn of control handle shall correspond to about .0625 inch travel on the flight gyro lever. The face of the indicator shall be properly marked to indicate direction of motion of the handle for "nose up" or "nose down".

1000d. The orientation of the handle shall be such as to give the pilot proper sensing for rotation of the control handle for nose-up or nose down condition.

1000e. The location of the handle and scale shall be such that it will be within sight and reach of the pilot during flight, and positioned so that the control shafting to the flight gyro will negotiate a minimum number of bends.

1001a. The bomb rack installation shall be in general accordance wi Bureau of Aeronautics Specification SR-22B so far as that specificatio is applicable. Provision shall be made for each bomb and fuse mentioned. The installation shall consist of the following main items:

I.A. 1000# Class Bomb Installation - Two Bombs

2 - Demolition bombs, 1000# Class*	2000.
4 - Bomb racks complete, Mark XXXV-6 (B.O.267622) and solenoids Mark XVII-1	92.
1 - Mark XV-4 bombsight complete (B.O.264826)	35
1 - Emergency release system (Furnishings)	
2 - Pilot director indicators (non-magnetic type)	1.2
2 - Arming and release handles, Mark XXIX (B.O.147590)(Furnishings)	
Wiring, control cables, sheaves, fairleads,etc. (Weight Empty)	
1 - Firing Key NA-41A	1.25
2 - Sets of bomb chocks	10.4
	2139.9

BY

CHECKED

APPROVED

I.B. 1000# Class Bomb Installation - Four Bombs

4 - Demolition bombs, 1000# Class*	4000.
4 - Bomb racks complete Mark XXXV-6 with solenoid Mark XVII-1	92.0
1 - Mark XV-4 bombsight complete (B.O.264826)	35.0
1 - Emergency release system (Furnishings)	
2 - Pilot director indicators (non-magnetic type)	1.2
2 - Arming and release handles, Mark XXIX (B.O.147590)(Furnishings)	
Wiring, control cables, sheaves, fairleads, etc.(Weight Empty)	
1 - Firing Key NA-41A	1.25
2 - Sets of bomb chocks	10.4
	4139.9

*Provision for 1000# Class bomb shall mean provision for any of the following bombs and fuses:

Mark V (B.O.227487) with nose fuses Mark XIII-2 (B.O.163650) and Mark XXI (B.O.164943)
Mark IX (B.O.227488) with nose fuses Mark XIII-2 (B.O.163650) and Mark XXI (B.O.164943)
Mark XIII (B.O.227489) with nose fuse Mark XXI (B.O.164943)
Mark VII (B.O.227481)(water filled practice bomb)

II. 500# Class Bomb Installation - Four Bombs

4 - Demolition bombs, 500# class**	2000.
4 - Bomb racks, Mark XXXV-6 (b.O.267622) and solenoids Mark XVII-1	92.0
1 - Mark XV-4 Bomb sight complete (B.O.264826)	35.
1 - Emergency release system (Furnishings)	
2 - Pilot director indicator (non-magnetic type)	1.2
2 - Arming and release handles, Mark XXIX (b.O.147590)(Furnishings)	
Wiring, control cables, sheaves, fairleads, etc. (Weight Empty)	
1 - Firing Key NA-41A	1.25
2 - Sets of bomb chocks	10.4
	2139.9

**Provision for 500# class bomb shall mean provision for any of the following bombs and fuses:

Mark III Mod.1 (B.O.227490) with nose fuses Mark XIII-2 (B.O.163650) and Mark XXI (B.O.164943)
Mark IX (B.O.227491) with nose fuses Mark XIII-2
Mark XII (B.O.227492) with nose fuses Mark XXI (B.O.164943)
Mark V (B.O.147524) water filled practice bomb
Mark XI (B.O.227482) water filled practice bomb

BY

CHECKED

APPROVED

III. 100# Class Bomb Installation - 12 Bombs

12 - Demolition bombs 100# class**	1392.
4 - Bomb racks - Mark XLII (B.O.178401)	208.
1 - Mark XV-4 Bombsight complete (B.O.264826)	35.
1 - Emergency release system (Furnishings)	
Arming and release handles (Weight Empty	
Electric release switches (Weight Empty)	
Wiring, control cables, sheaves, fairleads, etc. (Weight Empty)	
1 - Firing Key NA-41A	1.25
External supports for Mark XLII Bomb Racks	24.0
2 - Pilot director indicators (non-magnetic type)	1.2
	1661.5

**Provision for 100# class bomb shall mean provision for any of the following bombs and fuses:

Mark I, Mod.III (B.O.227494) with nose fuse Mark XIX-1 (B.O.16368
Mark IV, (B.O.227509) with nose fuse Mark XIX-1 (B.O.163688)
Mark VII (B.O.147527) water filled practice bombs
Mark XV (B.O.204276) water filled practice bombs

NOTE: The above bombs except Mark I Mod.III can be carried in Mark XXXV racks.

1001b. The bomb rack installation shall be in general accordance with Bureau of Aeronautics Specification SR-22B. The Contractor shall provide necessary fittings and supports for the installation. The racks shall be so located that there is no possibility of the bomb striking any part of the structure after release.

1001c. Two Mark XXXV bomb racks shall be installed within the wing on the underside of the center panel outboard of the wing struts on each side of the airplane. The fittings for carrying the bomb racks shall be designed to carry a bomb load of not less than 2000 rounds on each wing with the load factors specified in Bureau of Aeronautics Specification SR-22B.

1001d. The bomb release controls shall be installed in the bomber's compartment. The controls shall be so installed that they may be easil reached and operated by the bomber at the sight. The controls, sheaves and supports shall be designed to withstand a gross pull of 200 pounds applied at the release handle.

1001e. The Contractor sha l design, furnish and install all neces-sary bomb chocks, including hocks for 100# class bomb and Mark V water filled practice bombs carrie on Mark XXXV bomb racks. No chocks are needed for bombs carried on ark XLII bomb racks.

1001f. Release cables sha l be so arranged that inspection and remova may be accomplished without itilating the airplane. The pull necessary

BY

CHECKED

APPROVED

to actuate the release handles shall be kept at minimum by giving release cables adequate fairleads. Anti-friction bearing pulleys of corrosion resisting construction shall be used throughout the release cable system.

1001g. The Contractor shall design, furnish and install the emergency bomb release system. The emergency system shall be so arranged that the entire bomb load may be released in salvo or in succession with sufficient rapidity to insure prompt jettisoning of the entire load. The emergency release system shall be operated from the pilot's cockpit.

1001h. Provision shall be made for mounting two Mark III bomb hoists on the wings for hoisting the 500# and 1000# bombs and 1935# torpedo from a bomb raft to the bomb rack when the airplane is afloat. The hoist is not carried in flight.

1001i. The arrangement of the 100# class bombs shall be as follows:

Normally 12 bombs are to be carried in 4 Mark XLII racks. The Mark XLII racks shall be carried outside the wing. Normal release shall be electrical, with manual release for salvo and emergency.

1001j. The electrical installation of the bomb racks shall be in accordance with Bureau of Aeronautics Drawing R-221.

1001k. Cables for bomb controls shall be 3/32" flexible tinned carbon steel cable.

1001l. Bomb release handles may be modified by the Contractor at his own expense subject to approval by the Bureau.

1001m. Portable platforms or equivalent satisfactory means shall be provided for personnel to permit loading of bombs and making adjustments.

1001n. Formation Bomb Release Signal - A formation salvo release system utilizing a signal of the photo flash bulb and reflector type, shall be provided. The signal shall be accessible to personnel in flight for replacement of bulbs. The signal shall be so located that when it is operated on the leading airplane of a bombing formation it will be visible from the pilot's cockpit of each of the other airplanes in the formation, whether the formation be stepped up, level, or stepped down, and it shall be so arranged as to be invisible from the surface under normal high altitude bombing conditions. The control of this signal shall be interconnected with the bomb release circuit in such a manner that the signal will function without delay when the bomb release circuit is energized.

1004a. Provision shall be made for the installation of the Mark XXVIII torpedo director in accordance with Bureau of Ordnance drawing No.227587. Naval Aircraft Factory report No.M-4069 dated 11 June 1939 describes an acceptable method of mounting the torpedo director on the prototype airplane.

1004b. Provision shall be made for carrying one Mark XIII torpedo under the wings on each side of the hull on a structure separate from the bomb racks for the 1000# bombs. Additional bomb racks will be furnished for this purpose. The installation shall be in accordance with Bureau of Aeronautics Specification SR-32 except as herein specified. The basic installation shall consist of the following main ite

2 - Torpedoes, Mark XIII	3870#
2 - Emergency release handles for pilot (Furnishings)	
2 - Torpedo starting mechanisms	0.6
2 - Torpedo propeller stops	2.8
1 - Torpedo director support (Furnishings)	
1 - Torpedo director, Mark XXVIII	3.0
2 - Sets torpedo chocks and supports	300. est.
1 - Firing Key, NA-41A	1.25
Cable Installation (Furnishings)	
4 - Torpedo slings (Furnishings)	
	4177.65

1004c. Torpedoes shall be carried parallel to the under side of th wing in flight and released in that attitude. The primery means of release for torpedoes shall be electric, however, mechanical release shall also be provided. The arrangement snall permit ready access to all torpedo accessories when the torpedo is in place.

1004d. The Contractor shall provide a stop bolt to fit the stop bolt socket in the torpedo.

1004e. The Contractor shall design, furnish, and install all necessary supports, chocks and release gear for carrying torpedoes. The fittings and the structure on each side shall be designed for a torpedo load of 1935 pounds, with the factors specified in Bureau of Aeronautics Specification SR-32. The installation shall be such that there is no possibility of the torpedoes striking any part of the airplane structure after release.

1005a. The pyrotechnics installation shall be in accordance with Bureau of Aeronautics Specification SR-24A and shall consist of the following items:

14 - Aircraft parachute flares
2 - Very's pistol and 48 rds. of ammunition
2 - Smoke grenades with one handle
10 - Float lights

1005b. One Very's pistol shall be located in the waist gun compartment and one in the pilot's cockpit.

4 -	Very's cartridge containers Mark II (B.O.162676)	(Furnishings
2 -	Very's pistol (B.O.11254)	5.0
48 -	Rounds Very's ammunition	5.85
2 -	Very's pistol brackets (Furnishings)	
		10.85

1005c. Provision shall be made for carrying 14 aircraft parachute flares, Mark IV-1. Two of the flares shall be in containers in the rear part of the hull. Twelve flares shall be stowed in their sealed containers in separate racks for use as required. The controls shall be led to the pilot. The containers shall be furnished by the Contra and shall be watertight before and after release. However, the flare are not to be carried in the containers when the airplane is on the water. Racks shall also be provided for the 2 flares ordinarily carr in the flare containers.

*8 -	Aircraft parachute flares Mark IV-1 (B.O.115019)	156.0#
2 -	Release cable installations (Furnishings)	
2 -	Flare containers (Furnishings)	(Contractor furnished)
1 -	Flare release handle, M-2 (B.O.120457)	(Furnishings)
1 -	Rack for 14 flares (Furnishings)	
2 -	Flare holder supports (Furnishings)	
		156.0#

*Additional flares shall be carried only as required.

1005d. Racks to hold eighteen aircraft float lights shall be provid convenient to the tunnel gun opening.

18 - Aircraft float lights, Mark IV (B.O.181709)	45.0
Rack for float lights (Furnishings)	

1005e. Provision shall be made for stowage of two smoke grenades.

2 - H.C. smoke grenades, M-8 (B.O.190055)	3.6
1 - Handle for holding burning grenades (BuAero SK-772 or 773) (Furnishings)	
Rack for smoke grenades (Furnishings)	
	3.6

1006a. Provision shall be made for the installation of a Mark VII tow target reel. The provision shall include a mount for the reel and a removable pulley fairlead for leading the cable out through the tunnel gun opening.

BY_____

CHECKED_____

APPROVED_____

1007a. Provision shall be made for the installation and operation of one Mark V Mod.1 smoke tank, together with its accessories and controls. The installation shall permit dropping the tank in an emergency. The smoke tank shall be carried on the inboard bomb support o the left wing. The installation shall consist of the following main items:

1 - Smoke screen tank, Mark V. Mod. 1 (B.O.179156)	975#
1 - Bomb rack Mark XXXV (B.O.267622) and solenoid	23.
1 - Cylinder CO_2, Mark V Mod.1 (B.O.199095)	34.
Tubing, supports, and controls for releasing smoke and lowering discharge pipe (Furnishings)	
Bomb chocks	10.
	1042#

1007b. The cylinder of CO_2, the regulator, and the controls shall be so located in the hull compartment as to result in shortest practicable leads and maximum visibility for the operator. Necessary tubing and connectors shall be provided for carrying carbon dioxide from the cylinder to the smoke tank.

EQUIPMENT

1012a. Provision shall be made for the installation of type GO or type TBW radio equipment in accordance with Appendix V and Appendix XXXI, except as otherwise authorized by the Bureau.

I.	Main Radio Unit (GO Series)	235.
II.	Intersquadron Maneuvering Unit Model GF-3	63.
III.	Interphone Unit (9-place) Model	18.3
IV.	Radio Direction Finding Loop (Remote Control)	36.
V.	Connecting Cables, Insulators, Fixed Antenna, etc.	12. est
	Total	364.3#

1012b. Necessary fittings and supports shall be provided by the Contractor for mounting a DW type direction finder loop (Remote Control The loop shall be furnished by the Government and installed by the Contractor. The indicator and control shall be convenient to the radio operator.

1012c. Provision shall be made on the shelf above the radio table for mounting the units of the GO or TBW receiving unit equipment and frequency meter.

1012d. A 9-place interphone set shall be furnished by the Government and installed by the contractor. Plug-in boxes shall be provided for bomber, pilot, assistant pilot, radio operator, engineer, two waist gun and the tunnel gun positions, and the navigator. The installation part are chargeable to the weight empty.

BY

CHECKED

APPROVED

1012e. The Contractor shall furnish and install an external fixed antenna from the posts on the outboard after wing tips to a fitting on the fin. The lead-in shall be installed from the right leg of the antenna, a Type 61025 lead-in insulator located adjacent to the main radio transmitter. The posts at the wing tips shall be of sufficient height to permit 15" minimum clearance between the antenna wire and the wing surfaces including aileron in full up position. Suitable fittings shall be provided at each point of attachment of the antenna capable of withstanding a pull of 200# in the direction of the antenn Strain insulators (38787-1) in conjunction with hook attachment links (213089-1) at the top of the fin and brace wires at the wing are requi ed at all points of antenna attachment except for the lead-in insulato at the hull.

1012f. Maneuvering antenna shall be provided from a point on the leading edge of the starboard wing to a lead-in insulator (61016) over the radio compartment. A strain insulator (38787-2) and a hook attachment link (213089-1) are required at the outboard end.

1012g. The maneuvering antenna shall be connected to the DV set to serve as a sense antenna. A corrector wire including a hook attachment link (213089-1) shall be installed over the loop.

1012h. Provision for installation of radio equipment means that the Contractor shall provide necessary furnishings whereby the equipment may be mounted without additional fabrication, drilling, etc., by the operating units.

1012i. Provision for operating the GF equipment by the bomber shall be made.

1013a. Provision shall be made for the installation and stowage of the following navigating equipment for the navigator. Stowage facilities shall be subject to release by the Bureau:

2 - Pelorus drift sights and 4 base plates	5.
Miscellaneous charts	3.
1 - Chart board (portable) Mark II	2.8
1 - Mark III protractor	5.1
Navigational books	2.
Miscellaneous navigation articles,papers,dividers,computers, pencils,erasers	2.0
1 - Drift sight, Mark VII	18.0

BY

CHECKED

APPROVED

1013b. In addition, provision shall be made for stowing and locki up the following items of navigation equipment, convenient to the navigator:

2 Octants and cases	13.
2 Navigating watches	3.3
1 Pair binoculars	2.6

1013c. Suitable mounts shall be provided for the combination Mark II pelorus-drift sight located as follows: One in the bow, one on each side of the pilot's enclosure, and one at the tunnel gun position. The base plates shall be removable if necessary.

1013d. Provision shall be made for mounting a Mark VII drift sigh near the chart table.

1016a. Provision shall be made for the installation or stowage of the following equipment to be furnished by the Government:

1 - Set signal flags	2.
1 First aid package	2.6
1 Complete tool kit (airplane)	10.
Food (7 men at 10# each) Normal	70.
Water (7 men at 6# each in water breakers)(Normal)	42.
Miscellaneous personal effects (7 men)	70.
Miscellaneous bedding,blankets,etc.	35
Food (emergency)	70.
Water (emergency)(in water breakers)	98.
1 - Life raft Mark VII	64.
1 - Spot light, case, and base	9.
6 - Flashlights	7.8
1 - Water distiller unit and fresh water container	25.

1016b. Provision shall be made for the installation and stowage of the following equipment to be furnished by the Contractor for each airplane.

Rope (1-1/2" cir.Manila) 2 lengths 150' each	23.
Special tools for assembly & maintenance of airplane & engines	
1 - Set erection and maintenance instructions (2 sets for first airplane)	
1 - Buoy hook (with 160' of 1" cir.Manila rope)	6.
1 - Boat hook (8' length)	4.
2 - Pilot's Handbooks	
1 - Canvas bucket (3 gal. capacity)	2.
1 - Sea Anchor and 100' 1" cir.line)	20.
1 - Klaxon horn (electrically operated)	4.
2 - Airplane log books	
4 - Engine log books	
4 - Propeller log books	
14 - Aviator's log books	

BY

1017a. No provision shall be made for oxygen equipment.

CHECKED

APPROVED

APPENDIX I-A

GOVERNMENT FURNISHED MATERIAL

The following material shall be furnished by the Government and installed by the contractor in each airplane.

POWER PLANT

Item 1 - Two Pratt & Whitney Model R-1830-82 engines geared 16 to 9 and one engine instruction book.
2 - Two starters, Eclipse Series 4080-VCER-1 hand-electric inertia with integral booster coils, starter cranks, and remo contact switches.
3 - Two metal constant speed controllable pitch propellers, 3-blade 12' 0" diameter full feathering type, with anti-icing attachments and feathering control accessories, pumps, switches, and relays.
4 - Two engine driven fuel pumps with integral sylphon relief valves (3/4" pipe taps) and by-pass valves, PR-12B.
5 - Two constant speed propeller governor units.
6 - Two sets flexible pedestal mounts for engines.
7 - One auxiliary power unit, Type NEB-1A with bilge pump generator, control box, float chamber, and muffler.

INSTRUMENTS

Item 1 - Four airspeed indicators.
2 - Two turn indicators.
3 - Five altimeters.
4 - Two clocks (elapsed time)
5 - Two oil thermometers (outlet)(electric)(first airplane only
6 - Two compasses Mark IX.
7 - Two electric tachometer generators with 4 indicators (MK. V)
8 - Two inclinometers.
9 - 4 manifold pressure gages.
10 - One 28-point thermocouple set consisting of one indicator, two 18-point switches, 2 switch leads, 28 thermocouple lead 14 gasket type and 14 rivet type thermocouples (length of leads 25 feet)(first airplane only).
11 - Two single-point thermocouple sets each consisting of one indicator, one lead (25 ft.), connector, one 6-foot engine lead and one gasket type thermocouple.
12 - Two climb indicators.
13 - Two directional gyros, Mark IA without mounts.
14 - Two carburetor thermometers (electric type)(first airplane only).
15 - Three air thermometers, (electric type).
16 - Two artificial horizon indicators without mounts.
17 - One tachometer synchronizer unit (Mark V).
18 - One clock - standard AN-5726.
19 - Two suction regulating valves.
20 - One electrically heated pitot static tube.
21 - Two fuel pressure gages.
22 - Two oil pressure gages.
23 - Two oil thermometers - electric type.
24 - One suction gage.

BY

CHECKED

APPROVED

APPENDIX I-A (CONTINUED)

ELECTRICAL EQUIPMENT

Item 1 - Two generators type NEA-2D.
2 - Two batteries, type S-34 with integral containers.
3 - Eight electrical plugs (for MK. XVII-3 solenoids) Type AN-310 10S-2S.
4 - Two control boxes type NF-1D.
5 - Two batteries, type S-17 with integral containers.
6 - Two running lights, type F-3 and F-4 (with lamps).
7 - Ten lights, type D-25 - (with lamps).
8 - Eleven receptacles - type C-3.
9 - Indicator lights, 1 type B-32 , and 3 type B-33 (with lamps)
10 - One exterior light - type D-22 (with lamp and reflector NAF-38690-17).
11 - Two lights, type D-25, (with lamps, reflectors, NAF-38690-16 and globes NAF-38690-26).
12 - Four instrument lights - type A-21 (with lamps)
13 - One selector switch, type B-1, NAF-39961.

ARMAMENT

Item 1 - Eight bomb racks, Mark XXXV-6 (4 right hand and 4 left hand) including solenoids, Mark XVII-3.
2 - Four Very's pistol cartridge containers, Mark II (B.O.162676)
3 - One flare release handle, M-2 (double)(B.O. 120457).
4 - Two bomb release handles, Mark XXIX (B.O. 147590).
5 - One electric automatic flight control unit (less bomb sight).

EQUIPMENT

Item 1 - One first aid package.
2 - One 9-place interphone.
3 - Two chart boards, Mark II-A (first airplane only).
4 - One pelorus-drift sight and 4 base plates (first airplane onl
5 - Direction finder loop, type DW.
6 - Safety belts, 4 gunner type, 5 pilot type and 4 commercial type (for bunks).
7 - One life raft, Mark VII, first airplane only.
8 - One lead-out insulator (NAF-67858-1).

APPENDIX I-B

The following material shall be furnished and installed by the Govern ment on each airplane as required except as noted in Appendix I-A. However, the contractor shall make satisfactory provision therefor an also make trial installation in each airplane to insure satisfactory fit in service. Samples of this material will be furnished as requir for trail installation purposes.

ARMAMENT

Item 1 - Two .30 cal. flexible Browning aircraft machine guns, M-2 (B.O. 204674).
2 - One ring sights, Mark VI (B.O. 189730).
3 - One wind vane sights, D-4 (B.). 150305).
4 - Two ejected link containers, Mark III (B.O. 190208) .30 cal.
5 - Two ejected case containers, Mark III (B.O. 190206) .30 cal.
6 - Two gun mount adapters, Mark III (B.O. 190200) .30 cal.
7 - Two .50 cal. flexible Browning aircraft machine guns with muzzle stabilizers (B.O. 190714).
8 - 800 rounds .50 cal. ammunition with links in 24 magazine assemblies (B.O. 182413).
9 - 3500 rounds .30 cal. ammunition with links in Mark I magazin assemblies (B.O. 178456).
10 - One Mark XV-4 bomb sight complete (B.O. 264826).
11 - Two pilot directors - non-magnetic type.
12 - Four demolition bombs (500# class)(See paragraph 1001a).
13 - Two or four demolition bombs (1000# class)(See paragraph 100
14 - 12 demolition bombs (100# class)(See paragraph 1001a).
15 - Four bomb racks, Mark XLII (B.O. 178401).
16 - Two Very's pistols (B.O. SK-11254).
17 - 48 rounds Very's ammunition.
18 - Fourteen aircraft parachute flares Mark IV-1 (B.O. 115019).
19 - Eighteen float lights (B.O. 181709) Mark IV.
20 - Two H.C. Smoke grenades, M-8 (B.O. 190055).
21 - Two ejected link containers .50 cal. (B.O. 182418).
22 - Two ejected case containers, .50 cal. (B.O. 182419).
23 - Two gun mount adapters, .50 cal. Mark V (left hand)(B.O.2041 and Mark V-1 (right hand)(B.O. 264812).
24 - One post sight for .30 cal. tunnel gun Mark V (B.O. 204036).
25 - One ring sight for .30 cal. tunnel gun Mark VIII (B.O. 20403
26 - Two torpedoes, Mark XIII.
27 - One torpedo director, Mark XXVIII (B.O. 227587).
28 - One firing key NA-41A (NAF-39983).
29 - Two ring sights, Mark VII (B.O. 199170).
30 - Two post sights, Mark IV (B.O. 199170).
31 - One Mark VII tow target reel.
32 - One smoke tank - Mark V Model 1 (B.O. 2275 59).
33 - One cylinder CO_2 - Mark V Model 1 (B.). 199095)(for smoke tank installation).

BY

CHECKED

APPROVED

APPENDIX I-B (CONTINUED).

Communicating:

Material listed and referenced under paragraph 1012a, except as noted in Appendix I-C.

Navigating:

Item 1 - Miscellaneous charts, papers, pencils, etc.
2 - One chart board, Mark II.
3 - One pair binoculars.
4 - Two pelorus drift sights and 4 base plates.
5 - One Mark III protractor.
6 - One drift sight - Mark VII.
7 - Two navigator's watches.
8 - Two octants and cases.

Miscellaneous:

Item 1 - Food (as specified)
2 - Water (as specified)
3 - Airplane tool kit.
4 - Engine tool kits.
5 - Miscellaneous bedding, blankets, etc.
6 - Miscellaneous personal effects of crew.
7 - One life raft, Mark VII.
8 - One spot light, case, and base.
9 - One water distiller unit and fresh water reservoir.
10 - Mess gear for 7 men.
11 - mattresses and pillows for bunks.

APPENDIX I-C

The following items shall be included in the material to be furnished and installed by the contractor for each airplane.

POWER PLANT

Item 1 - Two AEL-1 fuel system units, Specification U-1.
2 - Two vacuum pumps, type B-3, Specification P-33.
3 - Two oil separators for vacuum pumps.
4 - One engine primer assembly complete - Specification M-199 - Type B-2.
5 - Two automatic oil temperature control and check valves, Specification M-307c, Appendix B-1, Class 4.

ARMAMENT

Item 1 - Magazine racks for .30 cal. flexible gun ammunition and for .50 cal. ammunition specified.
2 - Cable and wire systems for bomb, torpedo and smoke tank installations.
3 - Emergency bomb release system for bomb and torpedo installati
4 - Chocks for bomb and torpedo installations.
5 - Racks for 18 aircraft float lights.
6 - One handle for smoke grenades (Bu.Aero. SK-772 or 773).
7 - Two release cable installations for parachute flares.
8 - Rack for 14 parachute flares.
9 - Two flare containers for parachute flares and supports.
10 - Rack for smoke grenades.
11 - Gun mounts for all flexible guns.
12 - Gun latches as required.
13 - Supports for bomb racks and torpedo racks.
14 - Bomb and torpedo hoisting parts separate from Mark III hoists
15 - Very's pistol brackets.
16 - Two torpedo propeller stops.
17 - Two torpedo starting mechanisms.
18 - Torpedo slings and retrieving devices.

EQUIPMENT

Communicating:

Item 1 - Metal supports, shelves, etc., for mounting radio equipment specified under paragraph 1012.
2 - Radio spare parts locker and locker for classified matter.
3 - External radio antenna, lead-in insulators and supports.
4 - One lead-in insulator (NAF-213257-1)
5 - One lead-in insulator (NAF-37016) for "V" antenna.
6 - Four strain insulators (NAF-38787-1).
7 - One strain insulator (NAF-38787-2).
8 - Two hook attachment links, type 213089-1.

APPENDIX I-C (CONTINUED)

Miscellaneous:

Item 1 - Seat cushion for the engineer.
2 - Special tools for assembly and maintenance of airplane and engines.
3 - One chemical toilet and supply of chemicals and bags.
4 - Filler units for fuel system and for oil system.
5 - Covers for pilots' enclosures, bow enclosure and engines.
6 - Erection and maintenance instructions and container (2 copies for first airplane, one copy thereafter).
7 - One buoy hook with 100 ft. of 1" cir. manila rope.
8 - Rope (1-1/2" cir. manila) 2 lengths of 150 ft. each (Federal Specification T.R. 601).
9 - One boat hook (8 ft. long).
10 - Three hand fire extinguishers carbon dioxide (2# charge)
11 - One 31# Northill type non-magnetic anchor.
12 - One canvas bucket (3 gal. size).
13 - One sea anchor, and 100 ft. of 1" cir. line.
14 - One Klaxon Horn (electric)
15 - Complete anti-icing equipment for wings, fixed tail surfaces, and propellers, except as otherwise noted.
16 - Galley equipment.
17 - Two pilots' handbooks.
18 - Two airplane log books.
19 - Four engine log books.
20 - Four propeller log books.
21 - Fourteen aviators' log books.
22 - One portable fire extinguisher carbon dioxide (5# charge).
23 - Wheels, tires, brakes, and oleo struts for alighting gear

INSTRUMENTS

Item 1 - Two fuel flow meters
2 - One fuel quantity gage per tank
3 - One oil quantity gage per tank
4 - One hydraulic pressure gage

ELECTRICAL

Item 1 - Two type A-1b cut-outs.
2 - Two type A-1 cut-outs.
3 - One type A-2a ignition switch
4 - One Cannon plug SKC16-32SL dummy
5 - One Cannon receptacle SKC16-23-3/4B.
6 - Indicator lights for alighting gear

HYDRAULIC

Item 1 - Pumps, valves, accumulator, jacks, etc. as required for alighting gear.

BY

CHECKED

APPROVED

APPENDIX II-A

USEFUL LOAD - Detail Distribution.

The Useful Load as a bomber airplane with 2-1000# class bombs shall be as follows:

USEFUL LOAD			8826
CREW with parachutes and life jackets (7)		1400	
FUEL (500 gals.)		3000	
OIL (35 gals.)		263	
ARMAMENT		3111	
Flexible gun installation	755.8		
Forward - one .30 cal. complete	107.7		
Waist guns - two .50 cal. complete	581.2		
Tunnel - one .30 cal. complete	66.9		
Bombs and installation (2-1000#)	2139.9		
Very's pistol installation	10.8		
Parachute flare installation	156.0		
Smoke grenades	3.6		
Aircraft float lights	45.		
EQUIPMENT		1052	
Communicating - Radio	364.3		
Navigating	56.8		
2 pelorus-drift sights & 4 base plates	5.		
Binoculars	2.6		
Misc. charts,papers,pencils, etc.	5.		
Chart board, Mark II	2.8		
Mark III Protractor	5.1		
Navigational books	2.		
One drift sight, Mark VII	18.		
Two octants and cases	13.		
Two navigating watches	3.3		
Miscellaneous	630.4		
One tool kit	10.		
One first aid kit	2.6		
Food (normal and emergency)	140.		
Water (normal and emergency)	140.		
Six hand flashlights & batteries	7.8		
Canvas bucket	2.		
One life raft, Mark VII	64.		
Rope (300 ft.)(Manila)	23.		
One buoy hook and rope	6.		
One tool kit (engine)	12.		
One boat hook	4.		
One spot light, case and base	9.		
15 gal. fuel for auxiliary Pwr. Unit	90.		
2 gal. oil for auxiliary pwr. unit	15.		
Bedding, blankets, towels, etc. (7 Men)	35.		
Personal effects of crew. (7 Men)	70.		

BY

CHECKED

APPROVED

APPENDIX II-B

The Useful Load as a bomber with 4-500# class bombs shall be distributed as follows:

USEFUL LOAD			8826
CREW (7)		1400	
FUEL (500 gals.)		3000	
OIL (35 gals.)		263	
ARMAMENT		3111	
Flexible guns (Same as II-A)	755.8		
Bombs and installation	2139.9		
Pyrotechnics (Same as II-A)	215.4		
EQUIPMENT		1052	

APPENDIX II-C

The Useful Load as a bomber with 12-100# class bombs shall be distributed as follows:

USEFUL LOAD			8348
CREW (7)		1400	
FUEL (500 gals.)		3000	
OIL (35 gals.)		263	
ARMAMENT		2633	
Flexible guns	755.8		
Bombs and installation	1661.5		
Pyrotechnics	215.4		
EQUIPMENT		1052	

APPENDIX II-D

The Useful Load as a bomber airplane with two 1000# class bombs, 1000 gallons fuel and 60 gallons oil shall be 12014 pounds.

APPENDIX II-E

The Useful Load as a patrol airplane with 785 gallons fuel shall be distributed as follows:

USEFUL LOAD			8508
CREW (7)		1400	
FUEL (785 gals.)		4710	
OIL (50 gals.)		375	
ARMAMENT		971	
Flexible guns	755.8		
Provision for bombs	0.		
Pyrotechnics	215.4		
EQUIPMENT		1052	

APPENDIX II-F

The Useful Load as a patrol airplane with 1570 gallons fuel and 100 gallons oil shall be 13,593 pounds.

BY

CHECKED

APPROVED

APPENDIX II-G

The Useful Load as a bomber airplane with 4-1000# class bombs, 500 gallons of fuel and 35 gallons of oil shall be 10,826 pounds.

APPENDIX II-H

The Useful Load as a torpedo airplane with 2-1935# torpedoes, 500 gallons of fuel and 35 gallons of oil shall be 10,864 pounds.

BY

CHECKED

APPROVED

APPENDIX XIX.

Weights of Items of Government Furnished Material included under Weight Empty.

POWER PLANT

Two Pratt & Whitney Model R-1830-82 engines, geared 16 to 9, aircoole each including automatic carburetor, 2 magnetos, 28 spark plugs, ignition shielding, cylinder air deflectors, propeller attaching parts and residual oil and grease.

Navy dry weight - 2930 pounds, as installed weight	2960#
Two hand-electric inertia starters, Eclipse Series 40 each with integral booster coil and extension	102
Two propeller assemblies (controllable pitch 12' 0" diameter, full feathering, 3-blades)(less controls)	790
Two engine driven fuel pumps with integral sylphone relief and by-pass valves	5
Two constant speed propeller governor assemblies	12
Two sets flexible pedestal mounts	62
Two sets pumps, switches, and solenoid relays	47.

INSTRUMENTS

One automatic flight control unit, exclusive of bomb sight ...	143
Two artificial horizon indicators (less mounts)	9.
Four airspeed indicators	3.
Two turn and bank indicators	2.
Five altimeters	5.
Two clocks (elapsed time)	2.
Two compasses, Mark IX	6.
Two electric tachometer generators, 4 indicators	13.
Two inclinometers	0.
Four manifold pressure gages (electric)	4.
Two directional gyros without mounts	8.
Two climb indicators	3.
Two suction regulating valves	1.
Two single point thermocouple units	6.
Three air thermometers, electric	3.
One electric tachometer synchronizer unit	0.
One clock (standard)	0.
One electrically heated pitot static tube	1.
Two fuel pressure gages (electric)	2.
Two oil pressure gages (electric)	2.
Two Oil thermometers (electric)	2.
One vacuum gage	0.

ELECTRICAL EQUIPMENT

Two generators, type NEA-2D	90.
One selector switch, type B-1	1.
Two batteries, type S-34, and two S-17 batteries with integral cases	126.
One auxiliary power unit NEP with bilge pump, generator, control box and float chamber	120.

BY
CHECKED
APPROVED

ELECTRICAL EQUIPMENT (Cont'd.)

Two control boxes, type NF-1D	10
Two running lights, type F	1.
Ten interior lights, D-25 (with lamps)	3.
Eleven receptacles, type C-3	1.
Four indicator lights, B-32 and B-33 (with lamps)	0.
One exterior light - D-22 (with lamps and reflector)	0.
Two lights - D-25 (with lamps, reflectors and globes)	0.
Four instrument lights, A-21 (with lamps)	0.

FURNISHINGS

Two bomb release handles, Mark XXIX	3.
One flare release handle, M-2 (double)	0.
Four Very's pistol cartridge containers, Mark II (B.O.162676)	2.
Five pilot type safety belts	15.
Four gunner type safety belts	10.
Four bunk safety belts	7.
TOTAL	4594.

BY

CHECKED

APPROVED

LIST OF APPENDICES

(Note: Copies of Appendices may be obtained on application to the Bureau of Aeronautics).

I. Government Furnished Material.
II. Useful Load, Detail Distribution of
III. Consolidated Aircraft Corporation Drawing No. General Arrangement.
IV. Bureau of Aeronautics Specification No. SR-59B Displacement and Location of Auxiliary Floats.
V. Naval Aircraft Factory Drawing for GO Series Radio Equipment.
VI. Bureau of Aeronautics Drawing 790-SK - Mark IX Compass.
VII. Bureau of Aeronautics Drawing No. 6519 - Mark II Chartboard
VIII. Omitted.
IX. Bureau of Aeronautics Specification No. SR-16E - Electrical Bonding of Airplanes.
X. Bureau of Aeronautics Specification No. SR-8D - Installati of Electrical Equipment.
XI. Omitted.
XII. Bureau of Aeronautics Specification No. SR-15C - The Protec of Naval Aircraft and Parts.
XIII. Navy Aeronautical Specification, M-107b, Change No. 1 Carbon Dioxide fire Extinguishers, Light Weight, fixed type.
XIV. Bureau of Aeronautics Specification No. SR-1A - Towing and Mooring of Flying Boats.
XV. Bureau of Aeronautics Specification No. SR-20B - Riveted Fuel and Oil Tanks.
XVI. Bureau of Aeronautics Specification No. SR-47B - Design of Hoisting Sling for Airplanes.
XVII. Navy Department Acceptable List of Approved Materials.
XVIII. Bureau of Aeronautics Specification No. SR-2A - Insignia and Marking.
XIX. Weights of Items of Government Furnished Material Included under Weight Empty.
XX. Naval Aircraft Factory Drawing No. 56778 - Container for Fresh Water.
XXI. Bureau of Aeronautics Specification No. SR-45A - Measurement of Wing and Control Surface Areas.
XXII. Bureau of Aeronautics Specification No. SR-73B - Installation and Testing of Fuel Systems and Change No.
XXIII. Bureau of Aeronautics Specification No. SR-74A - Installation of Instruments and Navigational Equipment, Change No. 3.
XXIV. Drawing for Float Lines.
XXV. Drawing for Hull Lines.
XXVI. Bureau of Aeronautics Tentative Specification No. M-106 - A Portable Carbon Dioxide Fire Extinguisher, Light Weight Type for Airplanes.
XXVII. Bureau of Aeronautics Specification No. SR-77A - Installation of Flexible Hose Connections for Aircraft Fuel and Oil Lines.

BY

CHECKED

APPROVED

LIST OF APPENDICES (Cont'd.)

XXVIII. Navy Department General Specification for the Inspection of Materials.

XXIX. Bureau of Aeronautics Specification No. SF-1B - General Specification for the Design of Airplane Hulls and Float Type Landing Gear.

XXX. Bureau of Aeronautics Specification No. M-224A - Aircraft Engine Exhaust Collectors.

XXXI. Bureau of Aeronautics Specification SR-52B - Installatiln Instructions for GF Series Radio Equipment.